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MINERALOGICAL ABSTRACTS

VOLUME 15

NUMBER 2, JUNE 1961

CONTENTS

	Page
bstractors	i
ndex of authors	ii
ge determination and isotope mineralogy ...	73
pparatus and techniques	76
ibliographies and book notices	85
lay minerals	87
rystal structure	94
conomic mineralogy and ore deposits	101
xperimental mineralogy	113
emstones	121
Geochemistry	122
History and biography	128
Meteorites and tektites	128
Mineral data	130
New minerals	134
Physical properties of minerals and rocks ...	136
Rock-forming minerals and petrology	139
Topographical mineralogy	163
Various Topics	167

ABSTRACTORS

lbee, A. L. (A.L.A.), *U.S.A.*
ndrews, G. F. (G.F.A.), *Gt. Britain*
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rünenfelder, M. (M.G.), *Switzerland*
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Mitchell, R. S. (R.S.M.), *U.S.A.*
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Šípek, V. (V.Š.), *Czechoslovakia*
Skiba, W. (W.S.), *Gt. Britain*
Subramaniam, A. P. (A.P.S.), *India*
Tomkeieff, S. I. (S.I.T.), *Gt. Britain*
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White, W. A. (W.A.Wh.), *U.S.A.*
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Wilcox, R. E. (R.E.W.), *U.S.A.*
Winchell, H. (H.W.), *U.S.A.*
Yaalon, D. H. (D.H.Y.), *Israel*
Zussman, J. (J.Z.), *Gt. Britain*
Zwaan, P. C. (P.C.Z.), *Netherlands*

INDEX OF AUTHORS

Ackermann, K. J., 151
Ackermann, P. B., 149
Adams, J. A. S., 75
Agafonova, T. N., 145
Agrell, S. O., 76, 135
Ahrens, L. H., 87, 129
Aiba, M., 156
Akamine, H., 91
Albanese, J. S., 166, 168
Albareda, J. M., 93
Albers, J. P., 155
Alderman, A. R., 106
Alekseeva, V. M., 82
Alimarin, I. P., 83
Allan, J. E., 84
Allard, G. O., 157
Altenhofen, R. E., 95
Altschuler, Z. S., 133
Amelinckx, S., 136
Amstutz, G. C., 110
Anda, L. F. de, 160
Anderson, C. A., 85
Anderson, E., 120
Anderson, E. C., 129
Anderson, P. T., 104
Andrieux, C., 126
Anon., 163
Antal, P., 81
Antipov-Karataev, I. N., 92
Antun, P., 108
Appleman, D. E., 96
Arakelyan, O. I., 117
Araki, T., 99
Aramaki, S., 162
Arend, H., 137
Arkhangelskaya, L. S., 77
Arnold, H., 122
Arnold, J. R., 129
Asklund, A. M., 79
Assarsson, G. O., 79
Athavale, V. T., 84
Atkins, D. H. F., 83
Axelrod, J. M., 136
Azaroff, L. V., 87

Baas Becking, L. G. M., 127
Babuška, I., 94
Bächtiger, K., 109
Bagreev, V. V., 81
Bailey, E. B., 87
Baker, G., 112
Balakrishna, S., 136
Balashov, D. B., 137
Balchin, L. A., 84
Ballard, S. S., 137
Bambauer, H. U., 139
Bandyopadhyay, S. K., 149
Banerjee, B. K., 168
Banerjee, P. K., 103
Banerjee, S., 112
Banno, S., 156
Baranov, V. I., 76
Barnes, H. L., 102
Barnett, P. R., 122
Barth, H., 94
Barth, T. F. W., 148
Barton, P. B., *Jr.*, 118
Bartoshinskiĭ, Z. V., 121
Bataliev, A. D., 144
Bates, T. F., 92
Battey, M. H., 152
Beale, H. J., 82
Beals, C. S., 130
Bell, K. G., 125
Bellair, P., 159
Belov, N. V., 95, 114
Benda, W. K., 164
Benn, J. H., 168
Bennington, K. O., 148
Bentor, Y. K., 159
Ben-Yair, M., 90
Berg, L. G., 78, 115
Berman, R., 133
Berthet, P., 153
Bieri, R., 74
Bilgrami, S. A., 113
Bilibin, Yu. A., 85
Bindul', F. Ya., 77
Bisby, H., 84
Bjørlykke, H., 105, 109
Black, M., 87
Blackmon, P. D., 89
Blalock, J. L., 122
Blanquet, P., 81
Block, S., 119
Bloss, F. D., 127
Bloxam, T. W., 157
Boardman, R. L., 85
Bode, H., 80
Bodenheimer, W., 81
Boef, G. den, 81
Bohun, A., 137, 138
Boĭkova, A. I., 114
Bokshteĭn, B. S., 84
Bond, W. L., 94
Borchert, H., 111
Borg, I., 148
Borisenok, L. A., 123
Borisov, S. V., 95
Börner, R., 87
Borup, R. A., 131
Bothwell, D. I., 133
Boulanger, J., 154
Bouška, Vl., 97
Bowie, S. H. U., 84
Boyle, R. W., 73, 106, 107
Brace, W. F., 148
Bradley, W. F., 93
Bragg, L., 94
Brauer, G., 118
Breck, D. W., 119
Brieux de Mandirola, O., 82
Brindley, G. W., 93
Bron, V. A., 117
Brooks, R. R., 121
Brousse, R., 160
Brown, G. M., 143
Bruton, E. M., 121
Bryant, S. J., 166
Bryn, K. Ø., 152
Buday, T., 86
Buerger, M. J., 87, 99
Bullard, F. M., 160
Burcik, E. J., 93
Burke, K. C., 84, 152
Burley, B. J., 97
Burns, J. R., 122
Busch, W., 167
Buschendorf, Fr., 128
Butt, Yu. M., 117

Cahen, L., 73
Cahn, J. W., 100
Caillère, S., 112
Calmon, C., 119
Campbell, F. H., 168
Canney, F. C., 126
Cannon, H. L., 127
Cano-Ruiz, J., 93
Capitant, M., 84
Carpenter, A. B., 166
Carpenter, R. H., 103
Carr, M. H., 122
Carroll, D., 88, 89
Carter, W. D., 110
Casperson, W. C., 166
Cassidy, W. A., 129
Čech, Fr., 97
Černohorsky, M., 94
Čermák, J., 94
Černý, P., 163
Chakrabarty, K. L., 144
Chakraborty, K. L., 113
Chakravarty, P. S., 155
Chandler, T. R. D., 73
Chandrasekharan, V., 95
Chanz, P. N., 120
Chao, E. C. T., 122, 123, 136
Chapman, D. R., 129
Chapman, R. M., 127
Chaussidon, J., 89
Chen, Y.-V., 76
Chentsov, I. G., 125
Chesterman, C. W., 157, 159
Choquette, P. W., 158
Chowdhury, M. K. R., 103
Christ, C. L., 95
Clark, J. R., 95
Clark, R. H., 77
Clarke, W. J., 77
Clements, T., 158
Cleveland, G. B., 92
Clifford, T. N., 145, 147
Clough, C. T., 87
Cohen, A. J., 130
Colbertaldo, D. di, 111
Comer, J. J., 93
Compton, R. R., 149
Concilio, C. B., 89
Cook, B. P., 99
Cook, E. F., 159
Coombs, D. S., 156
Cooray, P. G., 155, 164
Corey, A. F., 132
Cormier, R. F., 130
Coufová, P., 137
Coulbourn, K., 166
Cox, K. G., 134
Creasey, S. C., 103
Crist, C. W., *Jr.*, 167
Crowley, M. S., 93
Crump, R. M., 142
Curtis, G. H., 75
Cuttitta, F., 78
Cuypers, R., 136
Czamanske, C. K., 101
Czayo, S. E., 164

Dance, D. F., 73
Darnley, A. G., 73
Das, D. K., 151
Dasgupta, S., 112
Datar, D. S., 91
Datta, J., 168
David, D. J., 84
Davis, D. G., 79
Davis, G. A., 157
Davis, R. J., 133
Dawson, K. R., 78
De, A. K., 81
Debnam, A. H., 126
Debras, J., 80
Debras-Guedon, J., 80
Degal'tseva, T. I., 84
Deicha, G., 167
Dekeyser, W., 93, 94
Delevaux, M. H., 73
Dennen, W. H., 87
Deriu, M., 160
Deshpande, S. P., 164
Dhaneswar, R. G., 84
Diamond, S., 92
Dilaktorskiĭ, N. L., 77
Doell, R. R., 95
Doetsch, G., 112
Dolivo-Dobrovolsky, V. V., 77
Drysdall, A. R., 132
Dudykina, A. S., 105, 148
DuFresne, A., 129
Dutta, D. P., 168
Dyson, P., 133
Dzotsenidze, G. S., 85, 160

Earley, J. W., 94
Eberhardt, P., 73
Edelman, N., 153
Edge, R. A., 78, 129
Edwards, A. B., 107
Edwards, G., 75
Eeckhaut, J., 84
Ehmann, W. D., 83
Eichoff, H.-J., 75
Elliott, R. A., 113
El Wardani, S. A., 126
Embrey, P. G., 96
Emeleus, C. H., 140
Emmons, R. C., 142
Endröi-Havas, A., 79
Erd, R. C., 164
Erickson, R. L., 125
Eskola, P., 132
Evans, H. T., *Jr.*, 96
Evernden, J. F., 75
Eversole, W. G., 119

Fabian, H., 80
Fairbairn, H. W., 130
Farquhar, O. C., 100
Farquhar, R. M., 87
Farrand, M. G., 148
Faure, H., 133
Favorskaya, M. A., 160
Fayaz, H., 164
Feller-Kniepmeier, M., 129
Feodot'ev, K. M., 116
Ferguson, R. B., 140
Fisher, D. J., 76, 98
Fisher, N. H., 111
Fisher, R. V., 161
Flanagan, F. J., 123
Fleener, F. L., 166
Fleischer, M., 122, 123, 130
Flerov, G. N., 83
Flesch, G. D., 76
Florence, T. M., 82
Fontbote, J. M., 93
Ford, R. A., 122
Ford, R. E., 110
Forster, I. F., 107
Foster, P. C., 166
Fox, H. A., *Jr.*, 93
Franceschetti, G., 111
Frank-Kamenetskiĭ, V. A., 88
Fraser, W. E., 153
Freeman, E. B., 97
Frenzel, G., 118, 135

EUND, F., 88
IEDMAN, M., 148
IEDRICH, G., 107
IEDRICH, O. M., 111
IPIAT, J. J., 79, 89
YE, J. C., 92
STER, J. M., 159
YFE, W. S., 147

ALAKHOV, F. YA., 118
ALLAGHER, D., 85
ALLANT, R. P., 166
NGOPADHYAY, P. K., 154
AON, M., 81
ARD, J. A., 96, 135
ASKIN, A. J., 93
AUER, Z. E., 83
AVELIN, S., 102
AY, P., 135
EBHART, J. E., 148
EISS, J., 73
ENTILE, A. L., 119
HAG, A. S., 82, 91
HOSE, S., 97
HOSH, S. K., 155
HOUSE, K. M., 91
IARDINI, A. A., 113
IL-AV, E., 164
ILL, J. E., 103, 104
ILL, J. R., 91
ILWOOD, M. E., 119
INZBERG, A. S., 128
JELSVIK, T., 111
JEMS, O., 80
LASS, H. D., 92
LASSER, F. P., 119
LAUSER, A., 142
LOGOCZOWSKI, J. J., 90
NATIV, G. M., 86, 142
NEVUSHEV, M. A., 121
ODLEVSKIĬ, M. N., 144
OLDSMITH, J. R., 99, 119
OLDSMITH, R., 148
OLOVACHEV, V. P., 95
OODWIN, A. M., 165
ORAI, M., 155
OSSE, R. C., 167
OSWAMI, A., 100
OTTARDI, G., 96
RABHAM, G. W., 87
RAF, D. L., 99, 119
RANDQUIST, W. T., 93
RANIER, C., 127
RANT, D., 86
REENBERG, S. A., 120
REIGERT, J., 133
RIESBACH, J. O., 166
RIFFITHS, J. C., 92
RIFFITTS, W. R., 78, 123, 126
RIGGS, D., 148
RIGOR'EV, D. P., 137
RIMALDI, F. S., 79, 136
RIP, E., 111
RÜNENFELDER, M., 75
UALTIERI, J. G., 121
UHA SARKAR, T., 113
UILLEMIN, C., 84
UITARD, G., 153
UNNING, H. C., 104
USTAVSON, M., 113

ABASHI, F., 84
AFNER, S., 95
AHN-WEINHEIMER, P., 154
ÄKLI, A., 140
ALE, F. H., 84
AMILTON, P.-K., 134

HANAOKA, T., 137
HANDIN, J., 148
HANS, A., 84
HANSHAW, P. M., 122
HANSON, A. W., 98
HANUŠ, V., 103
HARADA, Z., 108
HARDER, H., 126
HARKER, A., 87
HASHIMOTO, S., 155
HATHAWAY, J. C., 94
HATTORI, T., 108
HATUDA, Z., 124
HAUPTMAN, H., 98
HAUSER, E. A., 93
HAWKES, H. E., 118
HAWKINS, D. B., 126
HAY, R. L., 161
HAYASE, I., 123, 124
HAYASHI, H., 94
HAYDEN, R. J., 75
HEARD, H. C., 148
HEATON, L., 94
HEINRICH, E. W., 132
HELLER, S., 164
HELLNER, E., 95, 97, 99
HÉNIN, S., 93
HENLE, W., 75
HENRY, N. F. M., 87
HERZOG, L. F., 130
HEYSTEK, H., 94
HIGGS, D. V., 148
HINCKLEY, D. N., 87
HISS, W. L., 144
HOFMANN, U., 93
HOLDRIDGE, D. A., 88
HOLLAND, H. D., 101
HOLLER, A. C., 166
HONGSLO, T., 79
HONIG, J. M., 118
HOPPE, G., 74
HOPPE, W., 94
HOSKING, K. F. G., 78
HOUTERMANS, F. G., 73
HOWELL, P. A., 97
HOWER, J., 132
HUANG, W. T., 132
HUBBERT, M. K., 148
HUIZENGA, J. R., 83
HUNT, C. B., 125
HUNT, E. C., 125
HUNTER, H. E., 144
HUSS, G. I., 128
HUTTON, C. O., 133
HUZITA, K., 159

IIYAMA, J. T., 146
IMAI, H., 106, 109
INGAMELLS, C. O., 113
INGERSON, E., 128
INNES, M. J. S., 130
ISHIBASHI, M., 109
ISHIKAWA, T., 159, 161
ISKANDER, W., 112
ISSHIKI, N., 162
ITÔ, H., 137, 156
IVANOVA, V. P., 77
IVES, R. L., 168
IWAMOTO, S., 119
IWAO, S., 150

JACKSON, M. L., 93, 94
JACKSON, W. A., 81
JACOB, H., 168
JACOBSEN, W. R., 79
JANDA, I., 123
JANGG, G., 84
JANKOVIĆ, S., 113
JANUZZI, R., 166
JASKÓLSKI, S., 108
JEDWAB, J., 73
JEFFERY, P. G., 78, 81
JENSEN, M. L., 76
JOHAN, ZD., 97, 163
JONES, D. W., 98
JONES, R. E., 123
JONG, W. F. DE, 87
JONG, W. J. DE, 81
JORGENSEN, N., 166
JUNG, J., 160
JURKOVIĆ, I., 107

KAARSBERG, E. A., 136
KABADI, B. M., 82, 91
KADER, G. M., 92
KAIMAN, S., 119
KAĬNARSKIĬ, I. S., 116
KAMB, W. B., 98
KANTŮREK, J., 138
KAPITONOVA, T. A., 135
KAPLAN, B. YA., 84
KAPLAN, I. R., 127
KARDAKOV, K. A., 74
KARDYMOWICZ, I., 149
KARLE, I. L., 98
KARLE, J., 98
KARRENBERG, H., 159
KARYAKIN, L. I., 117
KASAMA, T., 159
KATO, C., 89, 156
KATSUI, Y., 161
KATZ, G., 131
KATZ, M. J., 121
KAUTSKY, G., 102
KAUTZSCH, E., 103
KAWAKAMI, T., 125
KAY, D. A. R., 139
KEELING, P. S., 89
KEMB, W. B., 135
KEMP, D. M., 83
KENNA, B. T., 76
KERR, G. T., 93
KERR, J. R. W., 81
KERR, P. F., 134
KETNER, K. B., 142
KHITAROV, N. I., 116
KHOPKAR, S. M., 81
KIGOSHI, K., 129
KILLICK, R. A., 83
KIMURA, Y., 125
KING, E. G., 138
KINKLADZE, K. A., 115
KINSER, C. A., 120
KINTER, E. B., 92
KISTLER, R. W., 75
KITAZAKI, U., 168
KLEINKOPF, M. D., 126
KLEMIC, H., 73
KLEMM, D. D., 112
KLUG, H. P., 99
KLÜPFEL, W., 160
KNORRING, O. VON, 133, 134, 145
KOBAYASHI, H., 155
KOCH, G., 93
KOCH, G. S., *Jr.*, 103
KODYM, O., *Sen.*, 86
KOIZUMI, M., 119
KOKUBU, N., 75
KOLLAR, F., 74
KONOPICKY, K., 80
KONTÁ, J., 90
KOREKAWA, M., 145
KORKISCH, J., 81
KORZHINSKIĬ, A. F., 114
KOSCHMAN, A. H., 158
KOSTOV, I., 145
KOSTYUK, V. P., 145
KOUTEK, J., 150
KOZLOWSKI, S., 90
KRAUME, E., 111
KRAUT, F., 112
KRAVCHENKO, G. T., 145
KRETZ, R., 146
KRIEGER, I. M., 93
KRIJN, G. C., 81
KRINOV, E. L., 87, 129
KRISHNAN, M. S., 85
KRISHNAN, R. S., 95
KRISHNASWAMY, R., 131
KRISTIANSEN, H., 80
KRIVÁŇ, M., 82
KRUCHKOVA, E. S., 80
KRUMMENACHER, D., 75
KRYUKOV, S. N., 84
KUELLMER, F. J., 97, 140
KULLERUD, G., 102
KUMAGAI, N., 137, 156
KUMARAPELI, P. S., 164
KUN, N. DE, 109
KUNO, H., 159
KURODA, P. K., 76
KURTSEVA, N. N., 131
KUSHIRO, I., 143
KUZNETSOV, V. I., 81
KYNASTON, H., 87

LAGANZA, R. F., 150
LAHIRI, H., 168
LANDAU, A. I., 113
LANDERGREN, S., 102
LANGMYHR, F. J., 79, 80
LAPIN, V. V., 131
LA PLACA, S., 138
LAPUTINA, I. P., 74
LAURO, C., 160
LAVES, F., 139
LAVROV, I. V., 117
LAWRENCE, L. J., 109, 165
LAWRIE, T. R. M., 87
LAYTON, W., 142
LAZARENKO, E. K., 86
LEAKE, B. E., 149
LEBEDEV, V. I., 115
LÉBL, M., 138
LEELANANDAM, CH., 164
LEGRAND, C., 150
LEININGER, I. K., 93
LEÍPUNSKAYA, D. I., 83
LELIAERT, G., 84
LEO, G. W., 133
LEONT'EVA, A. A., 115
LEVIN, B., 78
LEVIN, S. B., 113
LEVINE, H., 135
LEVINSON, A. A., 131
LEVY, C., 151
LINDBERG, M. L., 100
LINGEN, G. J. V. D., 110
LINK, R. F., 103
LIPSON, H., 87
LITTKE, W., 118
LITTLE, H. W., 109
LJUNGGREN, P., 149
LODDING, W., 92
LONG, J. V. P., 76
LOSEV, N. F., 84
LOVERIDGE, B. A., 83
LOVERING, T. S., 150
LOW, W., 122
LYASHKEVICH, Z. M., 144
LYONS, S. C., 93

Ma, T. Y. H., 158
McAtee, J. L., *Jr.*, 89
McCall, J. D. H., 159
McCarthy, K. A., 137
McConnell, D., 168
MacDonald, G. J. F., 148
MacEwan, D. M. C., 93
McGavock, E. H., 167
McKelvey, V. E., 85
Mackenzie, R. C., 88
MacKenzie, W. S., 140
Mahel, M., 86
Manning, P. I., 163
Mansour, A. O., 112
Marcin, E. J., 167
Marczenko, Z., 81
Marel, H. W. v. d., 88
Marmo, V., 101, 103
Marranzino, A. P., 78, 125
Marshall, C. E., 93
Martinet, B., 133
Martín-Vivaldi, J. L., 93
Maser, M., 99
Maska, M., 86
Matějka, A., 86
Matherny, M., 82
Mathur, S. C., 138
Matkovs'kiĭ, O. I., 86, 142
Matsumoto, T., 159
Maucher, A., 106
Maufe, H. B., 87
Maxwell, J. A., 78
Maxwell, J. C., 148
Mayeda, T., 75
Mchedlov-Petrosyan, O. P., 115
Medlin, W. L., 137
Megaw, H. D., 97
Mehler, A., 93
Mehta, M. M., 84
Menzer, G., 128
Mettikh, L. I., 115
Meyer, A., 162
Meyrowitz, R., 78, 100
Michel, H., 110
Michel, R., 153, 160
Mikhail, R. S., 120
Miller, K. T., 94
Millman, A. P., 127
Milne, I. H., 92, 94
Milton, C., 136
Milton, R. M., 119
Minato, M., 159
Mitchell, G. H., 86
Mitchell, R. S., 167, 168
Mitoff, S. P., 139
Mitra, R. P., 91
Mitra, S., 105, 112
Miyake, S., 79
Modak, K. V., 82
Molchanov, V. S., 114
Montal, J., 163
Mookherjee, A., 136
Moore, D., 127
Moorehouse, W. W., 165
Mooser, F., 160
Morgan, A., 163
Morgan, J. W., 83
Morimoto, N., 96
Morimoto, R., 159
Moriya, Y., 79
Morris, D. F. C., 83
Moss, A. A., 133
Mueller, M. H., 94
Mueller, R. F., 158
Mukherjee, B., 95, 168
Mukherjee, S., 113, 131
Müller, G., 160
Mumpton, F. A., 92, 93
Munck, S., 159
Murata, K. J., 161
Murray, H. H., 93
Mustafin, I. S., 80

Naboko, S. I., 162
Nagasawa, H., 161
Naha, K., 100
Naidu, P. R. J., 143
Nakagawa, H. M., 123, 125
Nakayama, I., 156
Nalivikin, D. V., 85
Narain, K., 91
Narbutt, K. I., 74
Nelson, B. W., 93
Neumann, R., 92
Neuvonen, K. J., 132
Newnham, R. E., 97
Newton, A. R., 132
Nicholson, R., 151
Nickel, E. H., 130
Nicol, A. W., 135
Nicolas, J., 150
Niggli, E., 154
Nikogosyan, Kh. S., 114
Nininger, H. H., 128
Nishimura, S., 89, 124, 125
Nockolds, S. R., 87
Noe-Nygaard, A., 159, 160
Nolan, T. B., 85
Nozawa, K., 91
Nuffield, E. W., 134

Oakes, D. T., 93
Obradovich, J., 75
O'Brien, J. K., 148
Ochsenfeld, W., 84
Oda, U., 126
Odé, H., 148
Oelsner, O., 110
Oftedahl, C., 102
O'Gara, W. T., 167
O'Hara, M. J., 144, 153
Oke, W. C., 78, 135
Olphen, H. van, 93
Ol'shanskiĭ, Ya. I., 114
Olya, A., 83
Oosterhout, G. W. van, 100
Orlova, I. G., 116
Ormsby, W. C., 93
Orowan, E., 148
Osmond, J. K., 75
Osthaus, B., 93
Ostrogorskaya, O. P., 131
Ostrovskiĭ, I. A., 116
Ovchinnikov, L. N., 102, 115
Overweel, C. J., 106
Owens, G. W., 167
Owens, J. P., 133
Ozhigov, E. P., 78

Pabst, A., 157
Paclt, J., 136
Palatnik, L. S., 113
Pan, C. L., 158
Pankey, T., 138
Papailhau, J., 77
Parachowiak, W., 90
Parkhomenko, E. I., 139
Parrish, D. B., 80
Parrish, W., 94
Pasteels, P., 75
Patchick, P. F., 164, 165
Patel, C. C., 79
Paterson, M. S., 148
Paul, J., 81
Peltola, E., 152
Perloff, A., 119
Petersen, K., 79
Pharr, R. F., 167
Phemister, J., 87
Phemister, T. C., 153
Phillips, E. R., 149
Phillips, R., 142
Piccoli, G., 151
Pichamuthu, C. S., 149, 155
Pinson, H. W., *Jr.*, 130
Pistorius, C. W. F. T., 139
Poljakowa, O. P., 108
Pollock, D. W., 110
Pommer, A. M., 89
Popov, M. A., 80
Poppe, H., 81
Post, B., 138
Pouba, Z., 112
Povarennykh, A. S., 136
Powell, B. W., 121
Preece, E. R., 73
Press, F., 87
Prider, R. T., 132
Prikhid'ko, N. E., 114
Prosser, V., 120
Prouhet, J., 151
Pulsford, J. M., 77
Pyke, R. E., 80

Quirk, J. P., 88

Radkewitsch, E. A., 108
Radoslovich, E. W., 93, 97
Radwan, Z., 82
Raguin, E., 153
Raja, N., 141
Rajagopal, E. S., 95
Rakić, S., 111
Randall, B. A. O., 152
Rankama, K., 87
Rao, B. A., 130, 131
Rao, C. N. R., 118
Rao, J. Y., 155
Rao, L. N., 151
Rao, M. V. R., 91
Rao, N. Y. V., 131
Rao, S. V. L. N., 140, 141
Rao, U. G. V., 131
Rashkovich, L. N., 117
Rasmussen, J., 160
Ratté, J. C., 106
Raup, D. M., 99
Rawson, D. E., 161
Razouk, R. I., 120
Redden, J. A., 157
Reddy, P. J., 136
Reed, G. W., 129
Reed, J. J., 150
Reed, T. B., 119
Regis, A. J., 119
Reitan, P. H., 152
Renfro, R. F., 167
Repenko, K. N., 117
Reyna, J. G., 105
Rice, R. V., 99
Richards, A. F., 159
Richards, R. A., 122, 165
Richardson, H. M., 118
Richardson, P. W., 118
Ricke, W., 122
Rijkheer, J., 83
Riley, C. M., 87
Rinehart, J. S., 129
Ringwood, A. E., 120, 121
Robertson, E. C., 148
Rogers, J. J. W., 76
Rose, E. R., 112
Ross, D. R., 135
Rottenberg, J. A., 130
Rowland, R. A., 93
Rowley, E. B., 166
Roy, D. M., 93, 135
Roy, R., 92, 93, 119, 135
Runcorn, S. K., 87
Rusanov, A. K., 82
Russell, R. D., 74, 87
Ryka, W., 90
Rŷskin, Ya. I., 114

Sachs, M., 130
Sadashivaiah, M. S., 143
Sadkov, V. I., 117
Saebø, P. Chr., 105
Sahama, Th. G., 76, 132, 141, 1
Sahu, K. C., 136
Saito, T., 105
Sakai, H., 73, 161
Saksela, M., 146
Salen, A. S., 120
Samoĭlov, G. P., 74
Sand, L. B., 93, 119
Sarma, S. R., 143
Sarrot-Reynauld, J., 153
Satō, K., 73
Sato, M., 80
Sato, T., 89
Satoru, U., 119
Saukov, A. A., 123
Savostin, A. P., 83
Savvin, S. B., 81
Šćavničar, S., 95
Schachner-Korn, D., 111, 128
Schmalzried, H., 139
Schmehl, W. R., 94
Schmidt, W., 80
Schneiderhöhn, H., 128
Schnepfe, M., 79
Scholz, A., 93
Schoppee, L. W., 165
Schormüller, J., 128
Schrenk, W. G., 80
Schröcke, H., 101
Schroll, E., 123
Schulek, E., 79
Schultz, L. G., 91
Schulze, G., 160
Schwander, H., 82
Schwartz, J., 165
Scolari, G., 110
Seaman, D. M., 166
Segerstrom, K., 161
Seki, Y., 144, 156
Semenov, E. I., 74, 135
Sementovskiĭ, Yu. V., 77
Sen, S. K., 141
Senftle, F., 138
Sen Gupta, D. K., 155
SenGupta, P. R., 164
Serdyuchenko, D. P., 151
Servais, A., 79
Shabŷnin, L. I., 147
Shacklette, H. T., 127
Shadle, H. W., 92
Sharkey, E. S., 82
Sharma, S. R., 141
Sharp, W. E., 120. 139
Shashkina, V. P., 86, 164
Shaw, D. M., 82, 123, 146
Shaw, W. H. R., 127
Shchepochkina, N. I., 118
Sheftal, N. N., 87
Shellenberger, T. E., 80
Shelud'ko, T. F., 145

HENDERSON, A. G., 143
HEPARD, A. O., 150
HERWOOD, A. M., 123
HLEPOV, V. K., 116
HUBA, I. D., 74
HUBNIKOV, A. V., 87
IDORENKO, E. F., 168
IGNER, P., 73
IMS, F. L., 167
INCLAIR, D. A., 82
INEL'NIKOV, N. N., 116
IROONIAN, H. A., 123
IVARAMAKRISHNAN, V., 75
KHIRTLADZE, N. I., 86
KINNER, B. J., 118
KIRROW, G., 149
KRZAT, Z., 141
MALES, A. A., 83
MEDLEY, J., 165
MIRNOV, V. I., 103
MITH, D. K., 95
MITH, D. O., 139
MITH, G. H., 73
MITH, H. T., 165
MITH, J. A. S., 98
MITH, J. V., 98, 140
MITH, R. L., 161
MITH, W. C., 164
MITH, W. L., 123, 135
MITS, D. W., 87
MOOT, T. W., 91
MULIKOWSKI, K., 154, 160
OKOLOVA, E. P., 143
TACEY, F. D., 139
TAKHOVSKAYA, Z. I., 137
TALEY, H. G., 76
TANĚK, J., 163
TANTON, R. E., 125
TANTON, R. L., 104, 105
TECKEL, F., 164
TEINER, R. L., 127
ŠTEMPROK, M., 108
TEPIEN, A., 81
TERN, T. W., 73, 75
TEVEN, T. A., 106
TEWARD, E. G., 99
TIEFF, L. R., 73
TOENNER, R. W., 128
TONE, J., 135
TRAUMANIS, M. E., 94
TRZYZEWSKA, B., 82
TUMPFL, E., 108
UBRAHMANYAM, S. V., 136
UBRAMANIAM, A. P., 154
UBRAMANIAM, M. R., 103
UDO, T., 93, 94, 119
ULLIVAN, C. J., 104
UN, M.-S., 166
UNAGAWA, I., 100
UTTON, J., 152
UZUKI, J., 106
UZUKI, Y., 155
VEC, H. J., 76
VERDRUP, T. L., 74, 105
VOBODA, J., 86
VYATLOVSKIĬ, A. E., 162
WINEFORD, A., 87, 92
ŸROMYATNIKOV, F. V., 116

TAKAHASHI, T., 79
TAKAHASHII, H., 93
TAMURA, T., 94
TATEKAWA, M., 124, 142
TAYLOR, C. A., 95
TAYLOR, H. F. W., 96, 135
TAYLOR, J., 139
TAYLOR, S. R., 129, 130
THAYER, T. P., 159
THOMAS, A. M., 83
THOMAS, T. L., 119
THOMSON, T. R., 88
TILLEY, C. E., 87
TILTON, G. R., 130
TOBI, A. C., 154
TOGARI, K., 120
TOGARI, S., 120
TOLER, L. G., 132
TOMCZYK, H., 90
TOMKEIEFF, S. I., 85
TOOKER, E. W., 93
TOROPOV, N. A., 114, 118
TOUILLAUX, R., 89
TOURTELOT, H. A., 91
TREHAN, Y. N., 100
TRNKA, J., 138
TRUMPER, L. C., 121
TSUTSUMI, T., 125
TUREKIAN, K. K., 122
TURNER, A., 118
TURNER, F. J., 147, 148
TYDINGS, J. E., 113

UEDA, T., 145
UHLIG, H. H., 129
UKAI, Y., 89, 125, 138
UNDERWOOD, F. A., 95
URASIMA, Y., 107
UREY, H. C., 75
USHAKOVA, E. N., 142

VANCOMPERNOLLE, G., 79
VAN DILLA, M. A., 129
VAN LOAN, P. R., 134
VAN TASSEL, R., 89, 133
VAN WAMBEKE, L., 126
VARDANYANTS, L. A., 77
VARSAVSKY, C. M., 129
VARSHAVSKAYA, É. S., 79
VENKATASUBRAMANIAM, V. S., 75
VEN-SIN, K., 135
VENUGOPAL, J. S., 143
VERHAEGHE, M. A. P., 162
VERHOOGEN, J., 147
VESASALO, A., 132
VEYL, G., 160
VI GARIO, G., 165
VILAR, F. M., 160
VILCHEZ, F. G., 90
VINAR, O. M., 86
VINCENT, E. A., 144
VISHVESHWARAIAH, K. N., 79
VISTELIUS, A. B., 122
VISWANATHAN, S., 151
VITÁSEK, E., 94
VIVALDI, J. L. M., 90
VLASOV, G. M., 160
VOGLIOTTI, F., 82
VOINOVITCH, I. A., 80
VOKES, F. M., 102
VOLAROVICH, M. P., 137
VOLBORTH, A., 98, 134
VOLKONSKIĬ, B. V., 117
VORMA, A., 134

WADA, K., 88
WALKER, F., 149
WALKER, G. F., 93
WALKER, G. P. L., 163
WALTON, B. J., 151
WALTON, E. K., 86
WARD, F. N., 125
WARK, I. W., 101
WARSHAW, C. M., 92
WASSERBURG, G. J., 74, 118
WATSON, J., 152
WATSON, K. D., 104
WAYLAND, R. G., 107
WEAVER, C. E., 94
WEBB, J. S., 126
WEBSTER, R., 121
WEBSTER, R. K., 83
WEEGE, R. J., 166
WEEKS, R. A., 85
WEHRENBERG, J. P., 75
WEIBEL, M., 81, 163
WEISS, A., 93
WEISS, E. J., 93
WELLS, F. H., 93
WELLS, R. A., 125
WENK, E., 142
WENTWORTH, R. H., 166
WEST, W. D., 162
WESTERVELD, J., 159
WEY, R., 89
WEYERER, H., 94
WEYL, W. A., 93
WHALEN, E., 107
WHITE, A. J. R., 151
WHITE, D. E., 125
WHITE, J. L., 93
WHITE, W. A., 91
WHITTAKER, E. J. W., 96
WHITTIG, L. D., 93
WIESER, T., 141
WILCOX, R. E., 76
WILKENS, M., 94
WILLIAMS, C. H., 80
WILLIAMS, D., 101
WILLIAMS, D. I., 84
WILLIAMS, F. A., 78
WILLIAMS, H., 161
WILLIAMSON, D. H., 153
WILLMAN, H. B., 92
WILSON, A. D., 78, 79
WILSON, H. D. B., 104
WILSON, J. S. G., 87
WISEMAN, J. D. H., 168
WITTLE, A. W. G., 131
WITUCKI, R. M., 93
WOLFF, G. A., 121
WOLFF, P. M. DE, 94
WOOD, W. H., 93
WOOSTER, W. A., 87
WRIGHT, W. B., 87
WRIGHT, Z., 130

YAALON, D. H., 90, 91
YAGFAROV, M. SH., 78
YAGI, K., 159
YASCHENKO, M. L., 79
YOKOI, T., 89
YOSHIZAWA, H., 156
YUN, I., 138

ZÄHRINGER, J., 128
ZALESSKY, Z., 80
ŽEMLIČKA, J., 92
ZEN, E-AN, 157
ZIMMERMAN, R. H., 93
ZOLOTUKHIN, V. V., 143
ZOLTAI, T., 95, 99
ZOUBEK, V., 86
ZUSSMAN, J., 93
ZWIERS, J. H. L., 88

MINERALOGICAL ABSTRACTS

Vol. 15—No. 2 June 1961

AGE DETERMINATION AND ISOTOPE MINERALOGY

TERN (T. W.), STIEFF (L. R.), KLEMIC (HARRY), & DELEVAUX (M. H.). *Lead-isotope age studies in Carbon County, Pennsylvania.* Prof. Paper U.S. Geol. Survey, 1960, **400B**, B45–48.

Uranium minerals in the basal member of the Mauch Chunk formation (Mississippian) near Jim Thorpe and in the upper part of the Catskill formation (Devonian) near Penn Haven Junction were formed near the end of the Jurassic or the beginning of the Cretaceous. K. S.

DARNLEY (A. G.), SMITH (G. H.), CHANDLER (T. R. D.), DANCE (D. F.), & PREECE (E. R.). *Ages of uraninite from two British localities.* Min. Mag., 1960, **32**, 654–658.

Uraninite from Geevor Mine, near St. Just, Cornwall, on analysis by the complete lead method gave an age of 290±7 m.y. Uraninite from a quartz-galena-blende lode traversing quartzites and quartz-mica schists at Tyndrum, Perthshire, gave by similar methods an age of 230±8 m.y. R. A. H.

BOYLE (R. W.). *Some geochemical considerations on lead-isotope dating of lead deposits.* Econ. Geol., 1959, **54**, 130–135.

Age determinations based on the lead isotope ratios of galena may be erroneous due to the fractionation of lead isotopes in geochemical processes. Experimental evidence suggests that the lead isotopes have different bond strengths in various minerals. The differential weathering and erosion of source rocks of the same age may produce sedimentary strata having markedly different lead isotope ratios, dependent on the various geochemical processes through which the lead has passed. Therefore, except in special cases, the lead isotope ratios recorded from lead deposits will not be related to the age of the deposit. Chemical factors, such as oxidation-reduction potential, sulfur potential, carbon dioxide potential, pH, adsorption, and organic activity, as well as the hydrochemistry of uranium and thorium, may also play a part in the fractionation of lead isotopes. Variations in the U/Th ratios in different sedimentary rocks derived from the same source area will have a marked effect on the accumulation of radiogenic lead with time. G. S. C.

SAKAI (H.) & SATŌ (K.). *Isotopic composition of the common lead of Japan.* Geochim. Cosmochim. Acta, 1959, **15**, 1–5, 1 fig.

The isotopic compositions of the leads are given for 14 galenas, 2 anglesites, 6 pyromorphites, and a hokutolite from Japan. The isotopic compositions show but little variation and there is no detectable fractionation of lead isotopes between the primary and secondary lead ores examined. R. C.

CAHEN (L.), EBERHARDT (P.), GEISS (J.), HOUTERMANS (F. G.), JEDWAB (J.), & SIGNER (P.). *On a correlation between the common lead model age and the trace-element content of galenas.* Geochim. Cosmochim. Acta, 1958, **14**, 134–149, 2 figs.

Lead isotope ratios and silver contents are given for 24 North African and 20 European (Alps) galenas. With a few exceptions, galenas with leads of model age in agreement with the age of the host formation occur in veins and have high silver contents. Alpine galenas $>$ 300 p.p.m., North African $>$ 800 p.p.m. Replacement lead ores with leads of model age older than the host formation have low or relatively low silver contents, Alpine galenas $<$ 100 p.p.m., North African $<$ 500 p.p.m. A few vein occurrences have similarly low silver contents. The data thus confirm the rejuvenation or migration hypothesis of the origin of 'telethermal' lead ores, and it is suggested that where the age of the host formation is known, determination of lead model ages would provide objective data for distinguishing between primary and derived or rejuvenated lead ores. In formations of unknown age the silver content of galenas might provide similar distinguishing criteria within any one area. R. C.

Russell (R. D.) & Kollar (F.). *Interpretations of variation in the isotope ratios of common lead.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **1**, 132–140.

Variations in the lead isotope ratios are the result of contamination of original or primeval lead by radiogenic lead. Of the three classes of leads which exhibit isotope ratio variations the meteoritic and conformable leads both appear to have developed in predominantly reducing conditions, and the conformable leads are believed to be of subcrustal origin. In certain anomalous leads the Th/U ratio is variable, suggesting an oxidising environment and therefore isotopic alteration under near-surface conditions. The broad geological problems are discussed. R. A. H.

Sverdrup (Thor L.). *The pegmatite dyke at Rømteland. A description of the minerals and a discussion of the mineral paragenesis, especially within the system* $(Fe,Mn)O$–TiO_2–Y_2O_3–$(Nb,Ta)_2O_5$–SiO_2. Norges Geol. Unders., 1960, **211**, 124–196, 29 figs.

The pegmatite body is located within an area of farsundite near Lindesnes, the south point of Norway. The boundary conditions and the zoning of the pegmatite are described and discussed. Age determinations on biotite and alkali-feldspar from the country rocks and the pegmatite (by W. Gentner by the K/A method) gave values, 483 to 759 m.y., which are apparently too low. Determinations on uraninite, euxenite, and thorite (Pb–Th–U isotope ratios by Kulp and Eckelman) gave 830 to 920 m.y. Calculation of temperatures of formation for the farsundite and the pegmatite by the two-feldspar thermometer [M.A. **11**–328] gave values around 650°C. The pegmatite is believed to be of magmatic origin. About 40 mineral species found in it are described, partly in great detail. Some were identified by X-ray powder photographs; in [some cases complete or partial chemical analyses are given. Minerals of special interest include:— uraninite crystals with coatings consisting of clarkeite–fourmarierite–kasolite–uranophane in successive layers; columbite, samarskite, euxenite; thorite and orangite; zircon, malacon, alvite, the composition of the latter in relation to zircon being especially considered; allanite with bastnäsite as an alteration product; beryl. The question of coexistence in chemical equilibrium and sequence of crystallization is discussed for various associations of pegmatite minerals, in particular for minerals containing rare earths and/or Nb, Ta, Ti.

I. W. O.

Narbutt (K. I.), Laputina (I. P.), Shuba (I. D.), Kardakov (K. A.), & Samoĭlov (G. P.)] Нарбутт (К. И.), Лапутина (И. П.), Шуба (И. Д.), Кардаков (К. А.) и Самойлов (Г. П.). Изотопный состав рудного свинца и возраст минералов, содержащих U, Th и Pb, по масс-спектрометрическим и рентгено-спектральным данным [*The isotopic composition of ore lead and the age of minerals containing U, Th, and Pb, according to mass-spectrometric and X-ray spectroscopic data*]. Труды института геологии рудных месторождений, петрографии, минералогии и геохимии [Trans. Inst. Geol. Ore-deposits, Petr., Min., & Geochem.], 1959, **28**, 122–137, 2 figs.

The ages of many minerals from localities in the Soviet Union have been determined by the lead isotope method, for example, on lead from galena (19 cases), and on lead from uranium minerals (8 cases). By means of X-ray spectroscopy ages ranging from 2390 to 140 m.y. have been determined for a large number of minerals. S. I. T.

[Semenov (E. I.) & Shuba (I. D.)] Семенов (Е. И.) и Шуба (И. Д.). О геологическом возрасте Ловозерского и других щелочных массивов Кольского полуострова [*On the geological age of Lovozero and other alkaline massifs of the Kola peninsula*]. Труды института геологии рудных месторождений, петрографии, минералогии и геохимии. [Trans. Inst. Geol. Ore-deposits, Petr., Min., & Geochem.], 1959, **28**, 138–141.

The ages of thorite, thorium-apatite, irinite auerlite, and zirconolite from Lovozero, Khibina, Keiva, and Africanda were determined by the X-ray spectroscopic method on the basis of Pb/Th ratio. The range of variation is from 400 to 312 m.y. with a mean of 350 m.y., namely Silurian in age. S. I. T.

Hoppe (G.). *Zur Frage des Auftretens übergrosser radioaktiver Höfe im Arnögranit.* Geol. Fören Förh. Stockholm, 1959, **81**, 485–494, 3 figs.

Unusually large pleochroic haloes have been described by Wiman [Bull. Geol. Inst. Univ. Upsala, 1930, **23**, 1] in granite from Halmsjön in Stockholm county. A reinvestigation of specimens of granite from the same region does not confirm Wiman's result. Some thorium-haloes with radius of 43·1 μ exceeding the range of Th*C′* might be an exception. This radius seems to be due to the large size and the diffuse boundary of the radioactive centergrain. The radii assigned to U are normal and the average of the measured values are: Ra*C′* 32·1 μ, Ra*A* 21·6 μ, Rn, Ra, 19·1 μ, Ra, Io, U*II* 16·3 μ, U*I* 12·8 μ, ? 9·3 μ, and ? 4·4 μ. E. W.

Wasserburg (G. J.) & Bieri (R.). *The A^{38} content of two potassium minerals.* Geochim. Cosmochim. Acta, 1959, **15**, 157–159.

Mass spectrometer determinations are given for the isotopic composition of A in muscovite from Michigan, U.S.A., and lepidolite from Southern Rhodesia. The value of $\lambda_{38}K^{38}$ given by E. K. Gerling et al. (1956) is too large by an order of magnitude. R. C.

VERNDEN (J. F.), CURTIS (G. H.), KISTLER (R. W.), & OBRADOVICH (J.). *Argon diffusion in glauconite, microcline, sanidine, leucite and phlogopite.* Amer. Journ. Sci., 1960, **258**, 583–604, 8 figs.

Numerical data show that diffusion causes substantial ss of argon from glauconite and illite at only 100°C if that mperature is maintained for a few million years, and from ica grains 1 mm thick at 300° for similar periods. iffusion in feldspar depends upon a complex of inter- and tra-grain processes. At all temperatures used, diffusion nstant in phlogopite is some 10^5 to 10^6 larger parallel to eavage than normal thereto, e.g., $1{\cdot}2\times10^{-18}$ and $2{\cdot}0\times10^{-13}$ n^2sec^{-1} at 300°C to 1×10^{-11} and $4{\cdot}3\times10^{-6}$ at 900°C. In ldspar, representative diffusion constants measured were the order 10^{-13} at 500° and 10^{-11} at 900°C ; in glauconite, $^{-16}$ at 300°C, 10^{-15} at 525°C ; in leucite, 10^{-10} at 500°C. n all, more than 75 individual observations of diffusion nstants are tabulated. In consequence of such losses of rgon, potassium-argon ages could appear to be 20×10^6 ears at 12,175 feet depth in cores from Kreyenhagen, and 5×10^6 at the surface. H. W.

AYDEN (R. J.) & WEHRENBERG (J. P.). *A^{40}–K^{40} dating of igneous and metamorphic rocks in western Montana.* Journ. Geol., 1960, **68**, 94–97.

Studied by the isotope dilution method, biotite of a resumed late-Laramide pegmatite in the Idaho batholith howed ages of 40·5 and 39·9 m.y. Biotite, K-feldspar, and ornblende from four Archean plutonic rocks showed ages anging from 1320 to 2450 m.y. R. E. W.

KRUMMENACHER (D.) & EVERNDEN (J. F.). *Déterminations d'âge isotopique faites sur quelques roches des Alpes par la méthode potassium-argon.* Schweiz. Min. Petr. Mitt., 1960, **40**, 267–277.

The diorite of Vico and the syenite of Traversella, both Sesia-Lanzo zone (Italy), gave 30–31 m.y. (in agreement with geology) ; the gneiss of Gran Paradiso (Aosta valley, Italy) 45 m.y. (older than Alpine orogenesis) ; the Mont Blanc granite (France, Italy) 41 m.y. ; and 5 granitic rocks of Aiguilles-Rouges massif (Wallis, Switzerland) 144–292 m.y. (too young). M. W.

PASTEELS (P.). *L'âge des halos pléochroiques du granite d'Habkern et de quelques roches du massif de l'Aar.* Schweiz. Min. Petr. Mitt., 1960, **40**, 261–266, 1 fig.

The haloes in biotite of northern Aar massif rocks are affected by epimetamorphism. The Habkern granite, found only as erratic blocks in ultrahelvetic flysch, is not metamorphosed and the age deduced from haloes is 300 m.y. M. W.

GRÜNENFELDER (M.) & STERN (T. W.). *Das Zirkon-Alter des Bergeller Massivs* [Switzerland & Italy]. Schweiz. Min. Petr. Mitt., 1960, **40**, 253–259, 1 fig.

Lead alpha age determinations on two zircon samples taken from glacial deposits in the northern Bergell massif (Graubünden, Switzerland), gave 25 ± 10 and 30 ± 10 m.y. (Oligocene). This is in accord with general opinion. M. W.

ADAMS (J. A. S.), OSMOND (J. K.), EDWARDS (G.), & HENLE (W.). *Absolute dating of the middle Ordovician.* Nature, 1960, **188**, 636–638.

For unaltered zircon from bentonite beds of middle Ordovician age $^{238}U : {}^{206}Pb$ ratios give 447 ± 10 m.y. Age determinations on zircon and biotite from another bentonite, by Faul and Tilton, give similar results. M. J. LE B.

SIVARAMAKRISHNAN (V.) & VENKATASUBRAMANIAM (V. S.). *Ages of some detrital monazites by the lead-alpha method of geochronology.* Proc. Nat. Inst. Sci. India, 1959, **25**, 278–280.

Ages of some monazites and cheralites from Kerala and a monazite from Yediyur near Bangalore, were determined by the lead-alpha method. The value for the latter is close to earlier determinations (2200 ± 100 m.y.). The Kerala minerals have the values cheralite 445 m.y., and monazite 735–775 m.y. ; they are thought to occur in pegmatites of late pre-Cambrian or early Cambrian age. A. P. S.

EICHOFF (H.-J.). *Spectrochemical rubidium-strontium method for geological age determination.* Appl. Spectroscopy, 1960, **14**, 74–76.

Rb and Sr in lepidolites are determined flame-photometrically, after preliminary ion-exchange separations, using In as an internal standard. The abundance of ^{87}Sr is determined spectrographically by examination of the fine structure of Sr 4078Å. R. A. H.

KOKUBU (N.), MAYEDA (T.), & UREY (H. C.). *Deuterium content of minerals, rocks, and liquid inclusions from rocks.* Geochim. Cosmochim. Acta, 1961, **21**, 247–256, 2 figs.

The water of basaltic and other rocks from Hawaii and Japan contains less deuterium than the average surface water of the earth, possibly due to the escape of protium equivalent to 4% of the oceans with a negligible loss of deuterium, or to the acquisition by the earth at its formation of surface water of high deuterium content and deeply buried water of low deuterium content. The D/H ratios for two micas from Missouri pegmatites have also been determined. Details are given for the extraction of water and its conversion to hydrogen by passage over heated uranium metal. R. A. H.

Kenna (B. T.) & Kuroda (P. K.). *The ratio of induced fission vs. spontaneous fission in pitchblende and natural occurrence of radiochlorine.* Journ. Inorg. Nucl. Chem., 1960, **16**, 1–7, 1 fig.

Chlorine was isolated from pitchblende from the Belgian Congo and from Great Bear Lake, purified, and its radioactivity determined. The specific activity was 7 and 4 disintegrations per min. per g of chlorine for the Congo and Canadian samples respectively, giving ratios of induced ^{235}U fission to spontaneous ^{238}U fission of 0·33 and 0·19. R. A. H.

Jensen (M. L.). *Sulfur isotopes and hydrothermal mineral deposits.* Econ. Geol., 1959, **54**, 374–394, 2 figs.

Magmatic hydrothermal sulphides show constant ratios with little evidence of isotopic fractionation during mineralization. Metamorphic hydrothermal sulphides exhibit variable ratios due to the fact that the mineralizing solutions have been derived from heterogeneous sources. Typical isotopic ratio values associated with sedimentary sulphides show enrichment in the lighter isotope. Oxidation of sulfur-bearing minerals may result in the formation of sulfate minerals under both hypogene and supergene conditions ; isotopic fractionation occurs in the former but has not been detected in the latter case. J. T. W.

Baranov (V. I.) & Chen (Yuĭ-Veĭ). [*Isolation of radiogenic calcium from mica for isotopic analysis.* Zhur. Anal. Khim., 1960, **15**, 163–165.] Anal. Abstr., 1960, **7**, abstr. 5160.

A method is described for isolating radiogenic Ca from lepidolite and muscovite, giving a yield of more than 90% of the total Ca. R. A. H.

Flesch (G. D.), Svec (H. J.), & Staley (H. G.). *The absolute abundance of the chromium isotopes in chromite.* Geochim. Cosmochim. Acta, 1960, **20**, 300–309.

Isotope determinations have been made on Cr in 18 chromite samples from countries responsible for 81% of the chromite production between 1900 and 1950. The natural abundances of the four isotopes, in atom %, are : ^{50}Cr 4·352, ^{52}Cr 83·764, ^{53}Cr 9·509, ^{54}Cr 2·375. The chemical atomic weight is thus calculated to be $51{\cdot}998_5 \pm 0{\cdot}001_3$. R.A.H.

APPARATUS AND TECHNIQUES

Optical, d.t.a., separating, & miscellaneous

Agrell (S. O.) & Long (J. V. P.). *The application of the scanning X-ray microanalyser to mineralogy.* Proc. 2nd Intern. Symposium X-ray Microscopy and X-ray Microanalysis, Stockholm, 1959, 391–400, 5 figs.

A scanning X-ray microanalyser for use with petrological thin sections of 45μ thickness is described, and factors affecting the use of the technique for the examination of minerals and rocks are briefly considered. The application of the method to the study of fine exsolution intergrowths is illustrated by the determination of Ca and Fe in the hypersthene host and the augite lamellae of an inverted pigeonite, Fe and Ti in a zoned magnesiohercynite, and Ni in kamacite and taenite in the Cañon Diablo and Charcas meteorites. To obtain an accuracy of the order of ±1% the use of internal standards or the application of corrections for fluorescence and absorption, usually requiring an estimate of the approximate composition of the specimen, is necessary [M.A. **15**–84] R. A. H.

Rogers (John J. W.). *Measurement of refractive indices in thin section.* Amer. Min., 1960, **45**, 741.

The Canada balsam mounting material is dissolved away with xylene. The xylene is washed out with acetone when the xylene reaches the outer edge of the rock slice. The section is then dried and immersion oils inserted under the edge of the cover glass. A. C. H.

Sahama (Th. G.). *Detection of zoning in orthorhombic and uniaxial colorless minerals.* Amer. Min., 1959, **44**, 1303–1305, 2 figs.

Birefringence of less than 0·0003 in successive zones in orthorhombic or uniaxial crystals in thin section can be detected and measured with the aid of a $\frac{1}{4}\lambda$ micaplate rotating (elliptical) compensator. B. H. B.

Fisher (Jerome D.). *Interference figures.* Indian Min., 1960, **1**, 11–23, 5 figs.

An essay on interference phenomena with the description of an interference-image projection-box designed by the writer. A. P. S.

Wilcox (R. E.). *Use of the spindle stage for determination of principal indices of refraction of crystal fragments.* Amer. Min., 1959, **44**, 1272–1293, 5 figs., 1 table.

A small, simple, inexpensive device is described which enables a mineral grain to be rotated 180° on one axis in the plane of a microscope stage while immersed in oil. The principal indices of refraction of a small crystal fragment between about 0·03 and 0·3 mm diameter, can be measured

with the same precision as by other common methods. Independent measurements or estimates of optic angle, optic sign, dispersion, and pleochroism, and relationships of optic and crystallographic planes can be made easily. Methods for proper orientation of the sample for principal index determinations are given for both conoscopic and orthoscopic illumination. Construction of the device and the method of mounting samples on the spindle are described in detail. B. H. B.

Vardanyants (L. A.)] Варданянц (Л. А.). Теория Федоровского метода [*Theory of the Fedorov method*]. Изд. Акад. Наук Арм. ССР [Publ. Acad. Sci. Armenian S.S.R.], Erevan, 1959, 191 pp., [English and Armenian summaries, pp. 175–189 & pp. 165–174].

A system of crystal orientation by orthoscopic procedures on the universal stage is developed by use of operational variants involving different combinations of rotational axes with respect to the crossed nicols. An equation of four independent and two dependent variables defines the stereographic locus of the wave normal projections. The stereogram curves of the normal, diagonal, and rotary variants always pass through the optic axes, those of the inversion variant through the symmetry axes of the indicatrix on the stereographic projection. [The curves of the rotary variant correspond to Fedorov's (1896) 'optical curves']. A familiarity with these theoretical forms enables the operator to manipulate the crystal into the desired cardinal orientations more rapidly and directly than by the former arbitrary procedures, some of which are regarded as misleading. R. E. W.

Clark (R. H.) & Clarke (W. J.). *A plastic universal stage for student use.* Amer. Min., 1960, **45**, 224–228, 2 figs.

The construction and use of a 3-axis stage made from perspex is described. A. C. H.

Dolivo-Dobrovol'skiĭ (V. V.)] Доливо-Добровольский (В. В.). Об оптических реакциях двойниковой оси при исследовании двойников на Федоровском столике [*On optical reactions of a twin axis during the study of twins on the Fedorov stage*]. Мин. Сборник Львовского Геол. Общ. [Min. Mag. Lvov Geol. Soc.], 1958, **12**, 406–417, 5 figs., [English summary].

As the Emmons five-axial stage does not provide a satisfactory result for establishing the twin axis, the six-axial stage or the Vardanyants five-axial stage is recommended. S. I. T.

Pulsford (J. M.). *Low magnification thin section photography.* Amer. Min., 1959, **44**, 1306–1307.

For low magnification thin section photography printing with a positive printing mask is recommended to compensate for the uneven field illumination usually encountered. For test exposures a geometric progression of times, e.g., 2, 4, 8, 16, 32 seconds, is suggested. B. H. B.

Papailhau (J.). *Appareil d'analyses thermiques pondérales et différentielles simultanées.* Bull. Soc. franç. Min. Crist., 1959, **82**, 367–373, 6 figs.

An apparatus is described for simultaneous differential thermal and thermogravimetric analyses, using a 0·3 g sample and temperatures up to 1250°C, in atmosphere or in a controlled current of gas. Results are given for kaolinite, dolomite, and calcite and for chalybite in a current of air, oxygen, and nitrogen. R. A. H.

[Sementovskiĭ (Yu. V.] Сементовский (Ю. В.). О зависимости между содержанием термоактивного вещества и площадью термографической записи [*On the relation between the content of thermoactive substance and the area of the thermographic records*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, 79–87, 5 figs.

A critical examination of published material leads to the conclusion that the relation between the amount of the studied substance and the area of the differential thermographic diagram cannot be expressed by a straight line, as often assumed, but by a curve. S. I. T.

[Dilaktorskiĭ (N. L.) & Arkhangel'skaya (L. S.)] Дилакторский (Н. Л.). и Архангельская (Л. С.). О некоторых вопросах методики термического анализа [*On certain problems of methods of thermal analysis*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth. conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, 88–96, 8 figs.

The effect of the following factors on thermal curves is discussed—shape of sample, constancy of mass or volume, weight of sample, length and diameter of the bore, velocity of heating, and the nature of the standard inert substance. S.I.T.

[Ivanova (V. P.) & Bindul (F. Ya.)] Иванова (В. П.) и Биндуль (Ф. Я.). Прибор-приставка к полярографу СГМ-8 для ускоренного микротермического анализа по методу дифференциальных кривых нагревания [*Apparatus-adjunct to polarograph SGM-8 for a rapid microthermal analysis according to the method of differential heating curves*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth. conf. exper. techn. min. petr.] Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, 72–78, 4 figs.

The apparatus and its method of working are described. By connecting the apparatus, which is provided with a micro-electric furnace, to a polarograph of a special construction, and disconnecting the mechanical connection of the potentiometer, the combined apparatus is transformed into a registering pyrometer. S. I. T.

[Berg (L. G.) & Yagfarov (M. Sh.)] Берг (Л.Г.) и Ягфаров (М. Ш.). Новый прецизионный термографический метод определения термических констант и тепловых эффектов [*A new precision thermographic method of determination of thermal constants and thermal effects*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth. conf. exper. techn. min. petr.]. Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.)], 1958, 63–71, 5 figs.

The new method is based on laws of the temperature field under conditions of quasistationary heating regimes. The block-furnace contains a double cylinder, the inner made of a thermoinsulator, the outer of a good thermal conductor. Within the inner cylinder are three chambers, for the sample, for the control sample and for the standard substance. Further details of the apparatus and methods of working are minutely described. S. I. T.

Williams (F. A.). *Use of high tension separation in dressing jig concentrates from decomposed columbite-bearing granite, Nigeria.* Trans. Inst. Mining & Metall., 1960, **69**, 1–17, 2 figs.

Close sizing and heating to between 100° and 110°C enabled effective high tension separation of magnetic zircon and orangite from columbite and cassiterite. R. A. H.

Cuttitta (Frank), Meyrowitz (Robert), & Levin (Betsy). *Dimethyl sulfoxide, a new diluent for methylene iodide heavy liquid.* Amer. Min., 1960, **45**, 726–728.

Dimethyl sulfoxide $(CH_3)_2SO$ is recommended as a diluent for methylene iodide. Methylene iodide can be recovered easily from the mixture by diluting with a large volume of water. A. C. H.

Griffitts (Wallace R.) & Marranzino (A. P.). *Fuller's earth as an agent for purifying heavy organic liquids.* Amer. Min., 1960, **45**, 739–741.

Fuller's earth is recommended for purifying heavy organic liquids from lead, copper, and zinc. A. C. H.

Edge (R. A.). *The recovery of chloroform from dithizone residues.* Anal. Chim. Acta, 1960, **23**, 199–200.

The chloroform used in the extraction and determination of Pb and Zn in geochemical investigations may be recovered by treatment with alkaline EDTA solution. R. A. H.

Hosking (K. F. G.). *Mineral identification using solid reagents.* Mining Mag., 1960, **102**, 287–292, 2 figs.

The fundamentals of the Russian technique of grinding a small portion of a specimen direct with a solid reagent with which the element in question forms a characteristically coloured substance are outlined. Details are given of tests for As, Ba, Bi, B, Ce, Cr, Co, Cu, Au, Pb, Mn, Mo, Ni, Os and Ru, Pd, Pt, Ag, S, Te Tl, Ti, W, V, and Zn. [M.A. **14**–455] R. A. H.

Ozhigov (E. P.). [*Detection of tin in ores by a grinding method.* Soobshch. Dal'nevost. Fil. Akad. Nauk SSSR, 1958, 129–130.] Anal. Abstr., 1959, **6**, abstr. 2081.

The ore is ground with dimethylglyoxime. The sensitivity is ≈0·5 mg. R. A. H.

Dawson (K. R.) & Maxwell (J. A.). *Possible loss of sodium and potassium during fusion of plagioclase feldspars.* Canad. Min., 1958, **6**, 288–290, 1 table.

—— *Identification of plagioclase by fusion technique.* Ibid. 1959, **6**, 390–394, 1 fig., 1 table.

The papers describe techniques for fusing plagioclase powder or fragments so that the refractive index of the glass may be used to yield the plagioclase composition using the graph of Foster [M.A. **13**–308]. In the earlier paper the samples were heated for 15 and 45 minutes in an acetylene-air flame and in an electric furnace at 1450°C. In the later paper the samples were heated for a few seconds in cratered carbon electrodes of an electric welding apparatus. In all cases, analysis for alkalis by flame photometer showed no significant loss in alkalis as a result of the fusion. R. B. F.

Oke (William C.). *Mineral micromounts.* Rocks and Minerals, 1956, **31**, 451–454, 3 figs.

A general discussion is given of the advantages of collecting mineral micromounts. The mounting and labelling of the specimens is considered. R. S. M.

Chemical : gravimetric & volumetric

Jeffery (P. G.) & Wilson (A. D.). *Closed-circulation systems for determining water, carbon dioxide and total carbon in silicate rocks and minerals.* Analyst, 1960, **85**, 749–755, 4 figs.

The principle of re-cycling air in a closed-circuit system is applied to the determination of water, CO_2, and total carbon in silicate rocks and minerals. Apparatus for these determinations is described. Blank values are always smaller than those obtained with conventional apparatus. Total water is determined either by the heating of the sample to 1000°C or by fusing it with a mixture of sodium

ngstate and borax glass ; total carbon is determined by e orthophosphoric-chromic acid method. Results are mpared with those obtained on silicate rocks by con-ntional methods. [M.A. **14**–5] R. A. H.

ANGMYHR (F. J.) & HONGSLO (T.). *Separation and gravimetric determination of niobium, tantalum and titanium by precipitation with N-benzoyl-N-phenyl-hydroxylamine.* Anal. Chim. Acta, 1960, **22**, 301–305.

Full details are given of the method, which has been used tisfactorily in the analysis of blomstrandine and euxenite. M.A. **15**–42] R. A. H.

RIMALDI (F. S.) & SCHNEPFE (M.). *Semimicrodetermination of combined tantalum and niobium with selenous acid.* Anal. Chem., 1959, **31**, 1270–1272, 1 fig.

A semimicro-gravimetric method for the separation and etermination of Nb and Ta from Ti and other elements ermits in a single precipitation the separation of 0·2 to 0 mg of Nb_2O_5 and Ta_2O_5 from 100 mg of the oxides of c, Y, Ce, V, Mo, Fe, Al, Sn, Pb, and Bi ; for Ti, Sb, Th, nd U two or three precipitations may be needed. The ethod has been applied to tantaloniobate ores [M.A. **4**–317]. R. A. H.

IORIYA (Y.). [*Separation and determination of boron in silicate by sintering with zinc oxide and sodium carbonate.* Japan Analyst, 1959, **8**, 667–671.] Anal. Abstr., 1960, **7**, abstr. 4153.

The borosilicate is sintered with a mixture of ZnO and Na_2CO_3 at 900°C for 10 minutes and extracted with water ; he boron is quantitatively dissolved as borate whereas only ninor Si enters the aqueous phase. R. A. H.

ATEL (C. C.) & VISHWESHWARAIAH (K. N.). *Potassium phosphate as a reagent for the gravimetric estimation of lithium.* Anal. Chem., 1960, **32**, 202–204.

Lithium can be quantitatively estimated as trilithium phosphate using as reagent a mixture of tripotassium phosphate and potassium hydroxide (pH 9·5), with 60% alcohol as the precipitating medium at 65° to 70°C. The method is applicable in the presence of potassium and sodium up to the following amounts : 5 parts K to 1 part Li, 4 parts Na to 1 part Li, 3 parts K and 3 parts Na to 1 part Li. D. A. M.

SSARSSON (G. O.), PETERSEN (K.), & ASKLUND (A. M.). *Eine Methode zur Bestimmung des Goldes in Sulfiderzen durch Extraktion.* Zeits. anal. Chem., 1960, **174**, 194–197, 1 fig.

Following the solution of the sulphide ore, Au is pre-ipitated, after the addition of $HgCl_2$, with hydrazine ulphate and sodium sulphide. R. A. H.

SCHULEK (E.) & ENDRÖI-HAVAS (A.). *Beiträge zur gravimetrischen Phosphatbestimmung.* Zeits. anal. Chem., 1960, **174**, 90–96.

Studies on the gravimetric determination of phosphate with Mg indicate errors of +0·6% to −0·3%. Phosphate may be determined in the presence of Ca, or of Fe^{3+} and Al, by the addition of EDTA. R. A. H.

YASHCHENKO (M. L.) & VARSHAVSKAYA (É. S.). [*Determination of potassium in mica by the perchlorate method.* Zavod. Lab., 1960, **26**, 275–276.] Anal. Abstr., 1960, **7**, abstr. 4662.

K is determined gravimetrically as $KClO_4$. R. A. H.

WILSON (A. D.). *The micro-determination of ferrous iron in silicate minerals by a volumetric and a colorimetric method.* Analyst, 1960, **85**, 823–827.

Decomposition of silicates is effected at room temperature by HF containing quinquivalent vanadium to oxidize ferrous iron as it passes into solution [M.A. **13**–257]. In the volumetric method the ferrous iron is determined by titrating the excess of vanadium. The colorimetric determination makes use of the reversible reaction $V^{5+} + Fe^{2+} \rightleftharpoons V^{4+} + Fe^{3+}$, the re-formed ferrous iron being determined by dipyridyl. Results are given for 13 rocks : for W–1 the volumetric method gave FeO 8·77%, and the colorimetric method gave 8·73 and 8·75%. R. A. H.

DAVIS (DONALD G.) & JACOBSEN (WILLIAM R.). *Determination of iron and iron-aluminum mixtures by titration with EDTA.* Anal. Chem., 1960, **32**, 215–217, 1 fig.

Iron alone can be titrated visually with EDTA at pH 2 to 3 but positive errors occur when aluminium is present. When the end point is determined spectrophotometrically at pH 1·0 the results are accurate in the presence of 2 parts Al to 1 part Fe. Reference is made to the determination of Fe and Al combined. D. A. M.

TAKAHASHI (T.) & MIYAKE (S.). *Titrimetric determination of soluble silica as molybdosilicic acid.* Talanta, 1960, **4**, 1–7.

The quantitative reduction of molybdosilicic acid by ferrous ammonium sulphate and oxalic acid, or by stannous chloride and sulphuric acid, permits the spectrophotometric determination of soluble silica to an accuracy of ±2·5%. R. A. H.

FRIPIAT (J. J.), VANCOMPERNOLLE (G.), & SERVAIS (A.). [*Study of the surface acidity of silicates and alumino-silicates by titration in non-aqueous media.* Bull. Soc. Chim. France, 1960, 250–259.] Anal. Abstr., 1960, **7**, abstr. 4706.

Details are given for the titrimetric study of the surface acidity of silicates. The method is illustrated by reference to the specific surface of a montmorillonite and two kaolinites. R. A. H.

Langmyhr (F. J.) & Kristiansen (H.). *Indirect EDTA-titration of aluminium with lead (II) solutions and 4-(2-pyridylazo)-resorcinol (PAR) as indicator.* Anal. Chim. Acta, 1959, **20**, 524–527. R. A. H.

Popov (M. A.). [*Complexometric titration of calcium in the presence of large amounts of aluminium (in fluorspar and other minerals).* Zavod. Lab., 1960, **26**, 540–542.] Anal. Abstr., 1961, **8**, abstr. 44.

R. A. H.

Mustafin (I. S.) & Kruchkova (E. S.). [*Hydron II—A new indicator for the complexometric determination of calcium in the presence of magnesium.* Zhur. Anal. Khim., 1960, **15**, 20–23.] Anal. Abstr., 1960, **7**, abstr. 4098.

R. A. H.

Gjems (Odd). *Stoicheiometry of titration of calcium, magnesium and manganese at low concentration with EDTA, with the metal indicators murexide and Eriochrome black T.* Analyst, 1960, **85**, 738–744.

R. A. H.

Zalessky (Z.), Debras-Guedon (J.), & Voinovitch (I. A.). *Dosage direct de calcium et de magnésium en présence de fer, aluminium et titane par le sel disodique de l'acide éthylènediaminetétracétique (EDTA).* Anal. Chim. Acta, 1960, **23**, 6, 523–530.

A volumetric method is described for the determination of Ca and Mg in the presence of Al, Fe, and Ti by titration with EDTA in the presence of tartaric acid and triethanolamine. The method is adapted for use with silicates.

R. A. H.

Sato (M.). *Rapid analysis of sphalerite by use of ion exchange resin and volumetric method.* Journ. Min. Soc., Japan, 1959, **4**, 293–298, 1 fig., (in Japanese).

Details are given of utilizing ion-exchange resins and a volumetric method for determining Zn, Fe, Cd, Mn, Cu, and S in sphalerite. There are several advantages in comparison with the ordinary method. M. S. J.

Chemical : flame-photometric and spectrophotometric

Williams (C. H.). *The suppression of calcium interference in the flame photometric determination of exchangeable sodium in soils.* Anal. Chim. Acta, 1960, **23**, 183–185.

The Ca interference in the determination of Na can b satisfactorily suppressed by the addition of similar amoun of Al and phosphate. [M.A. **14**–87, **15**–8] R. A. H.

Debras (J.) & Voinovitch (I.). *Dosage direct du strontiu par spectrophotometrie de flame en présence des élémen perturbateurs (Al, Ti, Fe, Ca, Mg, Na, K, Li).* C.R Acad. Sci., Paris, 1959, **248**, 77–80, 1 fig.

The suppression of the Sr emission at 460·7 mμ by th presence of Al is overcome by the addition of $CaCl_2$ to th solution of silicates before the flame-photometric dete mination of Sr. [M.A. **15**–8] R. A. H.

Debras-Guedon (J.) & Voinovitch (I. A.). [*Effect o 8-hydroxyquinoline in flame spectrophotometric analysis Direct determination of strontium, calcium, potassium sodium and lithium in the presence of interfering ion Emission of aluminium in the presence of 8-hydroxy quinoline.* Chem. Anal., Warsaw, 1960, **5**, 193–200 Anal. Abstr., 1960, **7**, abstr. 5162.

The emissions of Na, K, Li, Ca, and Sr are enhanced b the addition of 8-hydroxyquinoline. A procedure elimina ing the interference of other ions is described and is applie to aluminosilicates. The direct flame-photometric dete mination of Al is possible when the emission is enhance with 8-hydroxyquinoline. R. A. H.

Bode (H.) & Fabian (H.). *Zur flammenphotometrische Bestimmung der Elemente Gallium, Indium, Thallium* Zeits. anal. Chem., 1959, **170**, 387–399.

Extraction procedures are given for the determination o Ga in aluminium and zinc ores. The use of 0·5 *N* HC containing 80% by volume of acetone gives a 50-fol increase in sensitivity for Ga, In, and Tl. R. A. H.

Konopicky (K.) & Schmidt (W.). *Die Emissionserhöhun des Aluminium-Flammenspektrums durch Fluoridione* Zeits. anal. Chem., 1960, **174**, 262–268, 3 figs.

The addition of butanol and HF to Al-bearing solution in flame-photometric analysis gives an enhanced A emission at 484 mμ. Of the cations Na, K, Mg, Fe, Ca, an Ti, present in the proportions usual in clays, only Ca cause a slight reduction, which is corrected by the addition of C to the standard solutions. R. A. H.

Shellenberger (T. E.), Pyke (R. E.), Parrish (D. B.), & Schrenk (W. G.). *Some factors affecting flame photo metric emission of rubidium in an oxygen-acetylen flame.* Anal. Chem., 1960, **32**, 210–213, 4 figs.

The flame-photometric determination of rubidium i studied, and compared with the flame-spectrographi

)thod. Rb was measured at 780 mμ with Li (671 mμ) internal standard. Correction was made for the over-)ping K (770 mμ) line by background subtraction. The 'ect of K emission may be further controlled by adding cess K as a buffering ion. D. A. M.

ERR (J. R. W.). *The spectrophotometric determination of microgram amounts of calcium.* Analyst, 1960, **85**, 867–870, 2 figs.

In alkaline solution, Ca reacts with glyoxal bis-(2-droxyanil) to form a red complex which is stable in an ueous alcoholic medium and has an absorption maximum 520 mμ. Beer's law is obeyed in the range 0 to 4 p.p.m. Ca ; no interference is caused by up to 50 p.p.m. Mg Al. R. A. H.

AUL (J.). *Simultaneous [spectrophotometric] determination of silicon and phosphorus in the presence of each other.* Anal. Chim. Acta, 1960, **23**, 178–182, 2 figs. R. A. H.

CKSON (W. A.). *Colorimetric determination of aluminium in acid solutions of phosphate rock.* Journ. Agric. Food Chem., 1959, **7**, 628–630.

The interference of Fe in the colorimetric determination Al with Na alizarinsulphonate is avoided by converting into the cupferron complex and extracting it with HCl_3. R. A. H.

ARCZENKO (Z.) & STEPIEŃ (A.). [*Concentration and colorimetric determination of titanium, aluminium, iron and magnesium in rock-salt.* Chem. Anal., Warsaw, 1960, **5**, 247–259.] Anal. Abstr., 1960, **7**, abstr. 5142.

Ti, Al, Fe, and Mg were separated from a solution of rock lt by precipitation with 8-hydroxyquinoline at pH 9·5 to ·5, and determined colorimetrically. Over the range 0001 to 0·005% the accuracy is ±20%. R. A. H.

ODENHEIMER (W.) & GAON (M.). *Colorimetric determination of magnesium in silicates.* Bull. Res. Council Israel, 1958, **7A**, 117–120.

The working conditions for a method employing pre-pitation of Mg as $MgNH_4PO_4$, dissolution of precipitate HNO_3, and colorimetric measurement of P are given. M.A. **14**–7] D. H. Y.

EIBEL (M.). *Neue Methoden der chemischen Gesteinsanalyse.* Schweiz. Min. Petr. Mitt., 1960, **40**, 6–7.

The scheme of Shapiro and Brannock [Bull. U.S. Geol. rvey, 1956, **1036-C**] and that of Riley [M.A. **14**–87] are iscussed. M. G.

DEN BOEF (G.), DE JONG (W. J.), KRIJN (G. C.), & POPPE (H.). *Spectrophotometric determination of chromium (III) with EDTA.* Anal. Chim. Acta, 1960, **23**, 557–564. R. A. H.

JEFFERY (P. G.). *Detection of tin in tungsten minerals.* Rec. Geol. Surv. Uganda, 1955–1956 [Publd. 1959], pp. 43–44.

Tin can be identified by the red colour it gives with toluene-3:4-dithiol if citric acid is added to prevent the precipitation of the tungsten complex. Mo is extracted as the molybdenum complex, using light petroleum. The sensitivity is 0·001% Sn. R. A. H.

KUZNETSOV (V. I.) & SAVVIN (S. B.). [*Photometric determination of thorium in monazites with arsenazo II reagent.* Zhur. Anal. Khim., 1960, **15**, 175–179.] Anal. Abstr., 1960, **7**, abstr. 5199.

Th is determined in monazite without separation from impurities. A determination takes about 30 minutes and errors are >5%. [M.A. **14**–176, 240, 319, 320] R. A. H.

SAVVIN (S. B.) & BAGREEV (V. V.). [*Photometric determination of thorium in minerals by means of arsenazo III.* Zavod. Lab., 1960, **26**, 412–415]. Anal. Abstr., 1960, **7**, abstr. 5200.

The method is suitable for determining contents of Th <0·0001%. R. A. H.

KORKISCH (J.) & ANTAL (P.). *Zur Bestimmung von Mikrogrammengen Thorium in Silicatgesteinen, Sedimenten und anderen Materialen nach vorangehender Anreicherung des Thoriums mittels Ionenaustausches.* Zeits. anal. Chem., 1960, **173**, 126–138.

Enrichment of Th on Dowex 50 resin (H^+ form) and removal of interfering Ti and Zr by elution with citric acid permit spectrophotometric determination of Th in rocks and minerals by thoron. R. A. H.

BLANQUET (P.). [*Rapid colorimetric method for the determination of uranium.* Chim. Anal., 1959, **41**, 247–252.] Anal. Abstr., 1960, **7**, abstr. 974.

Full details are given for a colorimetric method, using a reagent solution of dibenzoylmethane, EDTA, and pyridine, which is applicable to minerals of unknown composition. R. A. H.

KHOPKAR (S. M.) & DE (ANIL K.). *Rapid extraction and spectrophotometric determination of uranium with 2-thenoyltrifluoroacetone.* Analyst, 1960, **85**, 376–379.

This method permits extraction and spectrophotometric determination of small amounts of U in one operation in 20 minutes and can be rendered selective by adding EDTA as a masking agent. R. A. H.

Florence (T. M.). *The direct determination of uranium in concentrates by spectrophotometric titration with ferric sulphate.* Anal. Chim. Acta, 1960, **23**, 282–288, 3 figs.

U in ores may be determined in little over an hour with a precision of 2–3 parts per thousand. R. A. H.

Vogliotti (F.). [*Rapid procedure for the spectrophotometric determination of uranium.* Energia Nucleare, 1960, **7**, 169–175.] Anal. Abstr., 1960, **7**, abstr. 4762.

For the analysis of ores U is extracted by a tributyl phosphate–benzene mixture from a solution containing KSCN, $Ca(NO_3)_2$, and EDTA at a pH of 1·3–1·8 and the extinction is measured at 421 mμ. R. A. H.

Spectrographic

Sinclair (D. A.), Beale (H. J.), & Sharkey (E. S.). *An airstream-stabilized d.c. arc source.* Spectrochimica Acta, 1960, **16**, 704–708.

G. D. N.

Sinclair (D. A.), Beale (H. J.), & Sharkey (E. S.). *Sources of variation in the nickel airstream-stabilized arc.* Spectrochimica Acta, 1960, **16**, 709–714.

G. D. N.

Schwander (H.). *Neue Anwendungen zur quantitativen spektrochemischen Bestimmung der Hauptkomponenten in Silikatgesteinen und -mineralien (Pressverfahren, Stallwood Jet).* Schweiz. Min. Petr. Mitt., 1960, **40**, 289–311, 3 figs.

A new spectrochemical scheme is proposed that should, in the authors opinion, give a better precision and accuracy than gravimetric analysis. Pressed electrodes, a CO_2 stream (Stallwood jet), and an intermittent d.c. arc of 12 amp are used. For the determination of Si, Al, Fe, Mg [and Ti], the electrode composition is 1 part sample, 1 part CuO, and 20 parts graphite, for the determination of Na, K, and Ca 1 part sample, 1 part $SrCO_3$, 3 parts Li_2CO_3, and 10 parts graphite. Internal standards are Cu and Sr. Several spectrochemical analyses by the author are compared with classical analyses of the same samples made by different people. Standard deviations seem to be about 1% for Si and 2–3% for the other elements. M. W.

Shaw (D. M.). *A vanadium-calcium spectral line coincidence at 3185Å and its effect on vanadium abundance data.* Geochim. Cosmochim. Acta, 1959, **15**, 159–161.

The enhanced sensitivity of V 3185 Å by Ca compound is spurious and is caused by Ca 3185 Å. Vanadium analyses made using the 3185 Å line on Ca-rich samples are probably in error. Spectrographic determinations of V in granite G–1 and diabase W–1 are given using V 3185 and V 3102 Å. R. C.

Alekseeva (V. M.) & Rusanov (A. K.). [*Quantitative determination of scandium by spectrographic analysis.* Zhur. Anal. Khim., 1960, **15**, 27–30.] Anal. Abstr. 1960, **7**, abstr. 4175.

Sc in silicate ores is determined by mixing 0·05 g of with 0·15 g of a mixture of equal parts of $SrCO_3$ and carbon together with 0·5% La_2O as internal standard. In the range 0·001 to 0·1% the mean error is ±10%.

R. A. H.

Ghag (A. S.), Modak (K. V.), & Kabadi (B. M.). *Spectrographic determination of manganese in Indian rubber grade china-clays.* Sci. & Culture, 1960, **25**, 593–59

Describes a quantitative determination of manganese by extraction with lead peroxide and nitric acid and comparing the optical density of the solution diluted with distilled water, using a Hilger photo-electric spectrometer.

A. P. S.

Brieux de Mandirola (O.). [*Rapid method for the spectrographic determination of rare-earth elements in monazite and cerium minerals.* An. Asoc. Quím. Argentina 1959, **47**, 90–98.] Anal. Abstr., 1960, **7**, abstr. 4694.

The rare earths are determined spectrographically at 250V d.c. using a 10 mg sample mixed with 120 mg $Ba(NO_3)_2$ which suppresses the cyanogen bands. All the rare earths, except Yb, can be determined to ±10%.

R. A. H.

Radwan (Z.) & Strzyzewska (B.). [*Direct spectrographic method of determination of uranium in residues after leaching of ores.* Chem. Anal., Warsaw, 1958, **3**, 73 744.] Anal. Abstr., 1960, **7**, abstr. 484.

U (0·01 to 0·1%) is determined spectrographically in the presence of Si, Al, Fe, Ca, and Mg. The 4241·7 Å line used for the total energy method and that at 4090·1 Å by the method of partial evaporation. R. A. H.

Kriváň (M.) & Matherny (M.). [*Quantitative solution spectral analysis of macro components of bauxite.* Chem. Zvesti, 1959, **13**, 796–802.] Anal. Abstr., 1960, abstr. 3774.

Al, Fe, Si, and Ti are determined, using a rotating disc carrier electrode; Ni is used as internal standard. Accuracies claimed are ±1·34% Al_2O_3, ±2·3% Fe_2O_3, 3·1% SiO_2, and 4·7% TiO_2. R. A. H.

Various techniques—neutron-activation, isotope-dilution, polarographic, etc.

Kemp (D. M.) & Smales (A. A.). *The determination of vanadium in rocks and meteorites by neutron-activation analysis.* Anal. Chim. Acta, 1960, **23**, 397–410, 7 figs.

Following irradiation in a pile, V is separated by chloroform-cupferron extractions and the activity determined by liquid counting. For G–1 and W–1 the average values obtained were 13 and 246 p.p.m. respectively. Results are also given for 9 Skaergaard gabbroic rocks (0·1 to 1730 p.p.m.) and for 7 meteorites (<0·2 to 77 p.p.m.).

R. A. H.

Kemp (D. M.) & Smales (A. A.). *The determination of scandium in rocks and meteorites by neutron-activation analysis.* Anal. Chim. Acta, 1960, **23**, 410–418, 1 fig.

Following irradiation, and a radiochemical separation, Sc is determined by gamma spectrometry. For G–1 and W–1 the average values obtained were 2·8 and 34 p.p.m. respectively : results are also given for 8 Skaergaard gabbroic rocks (7·5 to 52 p.p.m.) and for 5 stony meteorites (7·9 to 9·7 p.p.m.).

R. A. H.

Morris (D. F. C.) & Killick (R. A.). *The determination of silver and thallium in rocks by neutron-activation analysis.* Talanta, 1960, **4**, 51–60.

Use of the radionuclides ^{110m}Ag–^{110}Ag and ^{204}Tl, obtained by irradiation in a pile, allows determination of 0·01 p.p.m. Ag and Tl in a 1 g rock sample. The radiochemical techniques are described : results agree well with standard analyses.

R. A. H.

Morris (D. F. C.) & Olya (A.). *Determination of tantalum in rocks by neutron-activation analysis.* Talanta, 1960, **4**, 194–200.

Tantalum is determined as ^{182}Ta by γ-scintillation counting after extraction with tributyl phosphate. For G–1 and W–1 the values found were 3·0 and 0·93 p.p.m. Ta respectively.

R. A. H.

Loveridge (B. A.), Webster (R. K.), Morgan (J. W.), Thomas (A. M.), & Smales (A. A.). *The determination of strontium in rocks and biological materials.* Anal. Chim. Acta, 1960, **23**, 154–171, 5 figs.

Neutron activation and stable isotope dilution techniques are described for the determination of Sr. For G–1 and W–1 the values obtained are 252 and 172 p.p.m. respectively using neutron activation, and 236 and 180 p.p.m. by stable isotope dilution. Sr and U contents of 9 Skaergaard gabbroic rocks are also tabulated.

R. A. H.

Leĭpunskaya (D. I.), Gauer (Z. E.), & Flerov (G. N.). [*Neutron activation analysis of rocks and ore concentrates.* Atomnaya Energiya, 1959, **6**, 315–319.] Anal. Abstr., 1960, **7**, abstr. 1385.

Portable Po–Be sources for use in the field for minera prospecting permit the rapid determination of Al and Si in bauxite, Mn, Fe, and V in iron ore, and In in polymetallic ores.

R. A. H.

Atkins (D. H. F.) & Smales (A. A.). *The determination of tantalum and tungsten in rocks and meteorites by neutron activation analysis.* Anal. Chim. Acta, 1960, **22**, 462–478, 4 figs.

Radiochemical separation from the components of irradiated samples was employed to provide sources for measuring ^{182}Ta and ^{187}W by beta and gamma counting and by gamma spectrometry. The method has been used for 11 rocks from the Skaergaard intrusion and for various stony and iron meteorites. For U.S. Geol. Survey rocks G–1 and W–1 average results were : for G–1 Ta 1·59 p.p.m., W 0·40 ; for G–1 ground by the authors Ta 1·33 p.p.m., W 0·12 ; for W–1 Ta 0·48 p.p.m., W 0·43.

R. A. H.

Ehmann (W. D.) & Huizenga (J. R.). *Bismuth, thallium and mercury in stone meteorites by activation analysis.* Geochim. Cosmochim. Acta, 1959, **17**, 125–135, 1 fig.

Radiochemical procedures for the determination, following neutron activation, of Bi, Tl, and Hg in chondritic meteorites are described in detail. A ^{209}Bi abundance of $2{\cdot}2\times10^{-9}$ g/g was determined from 6 stone meteorites, and analyses of 5 stone meteorites gave a ^{203}Tl abundance of $0{\cdot}40\times10^{-9}$ g/g and a ^{202}Hg abundance of 30×10^{-9} g/g. The fact that chondrites contain only a very small amount of Bi relative to Th and U suggests that Bi has been fractionated from these heavier elements sometime in the past, as processes invoked to explain the abundances of Th and U are expected to have produced copious progenitors of ^{209}Bi.

R. A. H.

Rijkheer (J.). *Isotope dilution procedure for the determination of the true phosphate content of rock phosphates.* Journ. S. African Chem. Inst., 1960, **13**, 1–6.

In the gravimetric isolation of phosphate as NH_4MgPO_4 and ignition to $Mg_2P_2O_7$, weighed samples of standard $Mg_2P_2O_7$ labelled with ^{32}P are added and the specific activity of the final $Mg_2P_2O_7$ is compared with the standard.

R. A. H.

Savostin (A. P.) & Alimarin (I. P.). [*Determination of small amounts of tantalum and niobium in granite by the isotopic dilution method.* Vestn. Moskov. Univ. 1960, 45–48.] Anal. Abstr., 1960, **7**, abstr. 4227.

R. A. H.

Leliaert (G.) & Eeckhaut (J.). *Investigation of chemical separation methods for Ca and Sr. Quantitative determination of both elements in Ca-Sr mixtures by the isotopic dilution method.* Anal. Chim. Acta, 1957, **16**, 311–320.

R. A. H.

Bowie (S. H. U.), Bisby (H.), Burke (K. C.), & Hale (F. H.). *Electronic instruments for detecting and assaying beryllium ores.* Trans. Inst. Mining & Metall., 1960, **69**, 345–359, 9 figs., 2 pls.

Beryllium-bearing minerals may be detected in the field by the use of a portable electronic instrument using boron trifluoride counters to measure the neutrons emitted when Be is bombarded by γ-radiation of suitable energy. Full details are given of the apparatus and of similar apparatus for laboratory use. The limit of detection for a counting time of 10 minutes with a 100 mc ^{124}Sb source is about 5 p.p.m. BeO.

R. A. H.

Allan (J. E.). *Atomic-absorption spectrophotometry with special reference to the determination of magnesium.* Analyst, 1958, **83**, 466–471.

Mg can be determined with the same ease, reliability, and rapidity by the atomic absorption method as Na, K, and Ca by flame photometry. This method has been used for soil extracts ; appreciable Al must be removed.

R. A. H.

David (D. J.). *The determination of exchangeable sodium, potassium, calcium and magnesium, in soils by atomic-absorption spectrophotometry.* Analyst, 1960, **85**, 495–503, 1 fig.

R. A. H.

Kryukov (S. N.), Bokshteĭn (B. S.), & Degal'tseva (T. I.). [*Analysis of complex systems by the method of β-ray reflection.* Zavod. Lab., 1958, **24**, 1305–1308.] Anal. Abstr., 1959, **6**, abstr. 3356.

The analysis of mixtures of Fe, Mo, and W and the determination of Fe in ores are studied.

R. A. H.

Jangg (G.), Ochsenfeld (W.), & Habashi (F.). *Bestimmung geringer Urangehalte in Gesteinen und Rohphosphaten.* Zeits. anal. Chem., 1959, **171**, 27–37, 3 figs.

U in solutions of ores or rock phosphates is separated from accompanying metals by an ion exchange resin and determined polarographically as the nitrate.

R. A. H.

Kaplan (B. Ya.). [*Pulse-polarographic determination of lead, zinc, copper, thallium and indium in mineral raw materials.* Zavod. Lab., 1959, **25**, 1168–1172.] Anal. Abstr., 1960, **7**, abstr. 3617. R. A. H.

Athavale (V. T.), Dhaneswar (R. G.), & Mehta (M. M.). *Polarographic determination of traces of europium in minerals and ores.* Anal. Chim. Acta, 1960, **23**, 71–73.

A method is described for the determination of as little as 10–12 p.p.m. of Eu in minerals following the separation of the rare earths by conventional procedures. Results are given for a monazite (80 p.p.m.) and a samarskite (7 p.p.m.). R. A. H.

Balchin (L. A.) & Williams (D. I.). *The determination of niobium in titanium ores and pigments.* Analyst, 1960, **85**, 503–508, 4 figs.

A preliminary separation of Nb from Ti and Fe by solvent extraction with *iso*butyl methyl ketone is followed by polarographic determination of Nb. R. A. H.

Hans (A.). [*Elementary analysis by X-ray fluorescence.* Industr. Chim. Belge, 1960, **25**, 353–358.] Anal. Abstr., 1960, **7**, abstr. 5137.

The principles of X-ray emission and fluorescence spectroscopy are reviewed. The preparation of 10 g borax beads containing from 0·1 to 0·2 g of sample, giving the effect of massive dilution by a single known 'impurity', is described in detail. R. A. H.

Losev (N. F.). [*Quantitative X-ray spectrographic determination of platinum in ores.* Sb. Nauch. Trudy Irkutsk. Nauch.-Issled. Inst. Redk. Met., 1958, 25–28. Anal. Abstr., 1960, **7**, abstr. 1033.

The quartz crystal analyser is curved to a radius of 700 mm and Ta is used as internal standard, the analytical lines being Pt $L\alpha_1$, Ta $L\beta_1$, and Ta $L\beta_2$. R. A. H.

Guillemin (C.) & Capitant (M.). *Utilisation de la microsonde électronique de Castaing pour études minéralogiques.* Rept. 21st Intern. Geol. Congr., Norden 1960, Part **21**, 201–204.

The various applications of the electronic micro-probe are outlined. The area subjected to the electron beam may be less than 1 square micron. Examples quoted include the determination of the Co/Ni ratio in carrollite inclusions in chalcopyrite, the distinction of zircon and xenotime in microscopic inclusions and the semi-quantitative determination of Hf, the determination of Sc and Y in thortveitite, and the zonary distribution of Mn and Cr in garnets. [M.A. **15**–76] R. A. H.

BIBLIOGRAPHIES AND BOOK NOTICES

DLAN (T. B.), ANDERSON (C. A.), & MCKELVEY (V. E.). *Geological Survey Research* 1960. *Synopsis of geologic results.* Washington (United States Dept. Interior), 1960. U.S.G.S. Prof. Paper, **400A**, xii + 136, 4 figs. Price $1.

Geological Survey Research 1960. *Short papers in the geological sciences.* U.S.G.S. Prof. Paper **400B**, 1960, 515 pp. Price $4.25.

These volumes represent an experimental effort 'to digest d make available to all the new ideas and new dis- veries that have been achieved during the year to June 60' from the large programme of geological research dertaken by the U.S. Geological Survey. In addition to e synopsis of results volume A includes a list of investi- tions in progress [WEEKS (R. A.) & BOARDMAN (R. L.)], ranged by regions and by subject (pp. A77–105), and a t of publications [GALLAGHER (D.)] by officers of the ological Division, U.S.G.S., during the year (pp. A107– 7) with subject classification (pp. A127–136). There is index.

Volume B consists of 232 papers, generally less than 00 words in length, many of which are, or will be, noticed der their authors' names in the relevant sections of ineralogical Abstracts ; a short index is included.

J. Ph.

RISHNAN (M. S.). *Geology of India and Burma.* 4th edition. Madras (Higginbothams, Ltd.), 1960, xiv + 604 pp., 34 figs., 17 maps. Price R.22.50.

The first edition of this useful book appeared in 1943. the present edition introductions to the stratigraphical apters have been added to indicate, for comparison, the ain characters of each formation in western Europe. At e end of each stratigraphical chapter or section a summary the economic products of the formation and a selected bliography are given ; the mineral wealth of the Archaean s a separate chapter of 17 pp. and a bibliography of 69 ms. The latest data from age determinations of rchaean rocks and from chemical and petrological studies the charnockites of India are incorporated. J. Ph.

ALIVIKIN (D. V.), translated by TOMKEIEFF (S. I.). *The geology of the U.S.S.R.—a short outline.* Oxford (Pergamon Press), 1960, xii + 170 pp., 1 fig., with coloured geol. map of U.S.S.R. on the scale of 1 : 7 500 000. Price £5, $15.00.

This book provides a concise and authoritative account the geology of the whole of the U.S.S.R. To achieve this 170 pages has meant that each topic is very briefly ated, but the organization of the book seems to be such as to ensure that all the principal facts are included. The Union is divided into ten geological regions, a map of which is the one text figure, and one chapter is devoted to each. Most chapters are subdivided into sections on relief, stratigraphy, tectonics, magmatism, and economic deposits. Under magmatism, the igneous activity is divided into cycles, and the extent and general character of each is given. The sections on economic materials comprise sub-sections on metallic and non-metallic deposits and on fuels ; the chief occurrences are listed with an indication of their size, and recent discoveries are recorded. An extremely useful feature is the index, furnished by the translator, in which every place mentioned in the text is located by geographical coordinates. Regrettably, all literature references have had to be sacrified to compactness. The book is lightly bound, but is sold in a small stout box which also holds the map. This excellently produced coloured map, with trans- literated names, is a valuable part of the production.

M. H. B.

[BILIBIN (YU. A.)] Билибин (Ю. А.). Избранные труды. Том I [*Selected Works.* Vol. I]. Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, 432 pp. Price 26 r. 65 k.

This first volume contains reprints of papers by Yu. A. Bilibin (1901–1952) dealing with regional petrography and petrology ; his works on ore deposits will be included in the second volume. Besides a short introduction and bibliography the present volume includes the following titles : Crystallization of the undersaturated magma ; dissociation of molecules in a magmatic melt as a factor of magmatic differentiation ; mineral associations of magmatic rocks ; genesis of alkaline rocks, the problem of pseudoleucite ; leucite rocks of the Kolyma basin ; problem of formation of granites and ores ; and also a series of papers dealing with the regional petrology of various regions in Siberia.

S. I. T.

[DZOTSENIDZE (G. S.)] Дзоценидзе (Г. С.). Домиоценовый эффузивный вулканизм Грузии [*Pre-Miocene effusive volcanism of Georgia*]. Изд. Акад. Наук Груз. ССР [Publ. Acad. Sci. Georg. S.S.R.], Инст. Геол. Мин. [Inst. Geol. Min.], Моногр. I [Monograph I], Тбилиси [Tbilisi], 1948, 407 pp., 32 figs. Price —.

This is a book which provides a detailed account of the volcanic rocks of pre-Miocene age in Georgia, Caucasus. These rocks underlie about 18% of the country and they form ten distinct assemblages which fall into three distinct age groups : (1) pre-Jurassic, mainly Carboniferous—a small group consisting mainly of 'greenstones' [diabase],

green schist, and amphibolite ; (2) Jurassic, occupying very extensive areas in NW. Georgia, in places reaching 3 km in thickness, and extending to Armenia and Azerbaijan—principally composed of a spilite-porphyrite suite with a small amount of quartz-porphyry and quartz-albitophyre ; and (3) Cretaceous-Eocene, also represented by spilite and andesite lavas and tuffs. Two new terms are introduced—orotypal, instead of palaeotypal, and cratotypal, instead of kainotypal. The majority of volcanic rocks described in this volume belong to the geosynclinal orotypal assemblage. Two small sets, however, belong to the cratotypal assemblage ; these are a basalt–trachybasalt series of Upper Jurassic age, and a basalt–phonolite series of Cretaceous age. The geological setting, petrography, chemistry, and petrochemistry of the rocks are described in detail. A large number of chemical analyses, recast into Zavaritzky's petrochemical diagrams, is provided. Small maps show the distribution of the rocks and the bibliography contains 392 titles. In this detailed petrographical and petrochemical study of a particular petrographical province it is definitely shown that there is a close association between the magma erupted and the type of geotectonic activity. Various problems, such as the nomenclature of porphyrites, albitisation and spilites, uralitization of amphiboles, bowlingite formation, the nature of the pyroxenes, and the distribution and nature of zeolites in the lavas, are discussed.

S. I. T.

[Skhirtladze (N. I.)] Схиртладзе (Н. И.). Постпалеогеновый эффузивный вулканизм Грузии [*Post-Palaeogene effusive volcanism of Georgia*]. Изд. Акад. Наук Груз. ССР [Publ. Acad. Sci. Georg. S.S.R.], Геол. Инст. [Geol. Inst.], Монографии № 8 [Monographs, no. 8], Тбилиси [Tbilisi], 1958, 368 pp., 70 figs., 24 pls. Price 28 r.

This is a substantial volume complementary to that of G. S. Dzotsenidze [see previous abstract] as it deals with the Georgian volcanics of late-Tertiary to Recent age. These lavas and tuffs occupy about 10% of the total area of Georgia ; they occur in three regions—south Georgia, middle northern Georgia, and a number of volcanic areas adjoining the 'Georgian Military Highway' which crosses the main Caucasian chain and passes near the lofty extinct volcano of Kazbek. In all these regions the lavas and tuffs belong mainly to various parts of the basalt–andesite–dacite–liparite series. A good description is given of the numerous volcanic cones and lava flows. The book contains a large number of rock analyses, recalculated and plotted by the method of Zavaritzky, and some modal analyses. The field characters and petrography of the rocks are described, and optical data are given for the rock minerals. It is emphasised that the nature of the magma erupted depends on the nature of the geotectonic movements. The bibliography contains some 400 titles. S. I. T.

[Lazarenko (E. K.), Matkovs'kiĭ (O. I.), Vinar (O. M.), Shashkina (V. P.), & Gnativ (G. M.)] Лазаренко (Є. К.), Матковський (О. І.), Винар (О. М.), Шашкина (В. П.) & Гнатів (Г. М.). Мінералогія ви верженних комплексів Західної Волині [*Mineralogy of igneous complexes of western Volhynia*]. Вид. Львів. Унів. [Publ. Lvov Univ.], 1960, 509 pp., 264 figs., 1 map (Ukrainian, with Russian, pp. 482–487, and English, pp. 488–493, summaries). Price 27 r. 35 k.

This is a very extensive and well illustrated treatise on the minerals of igneous rocks of western Volhynia. The igneous rocks in this region are the pre-Cambrian Zhitomir-Kirovograd injection gneisses, migmatites, granites, and granite-pegmatites. These are followed by the Proterozoic Osnitzky complex comprising granite, gabbro, diorite, and porphyrite ; ending with a dyke-effusive complex, of late Proterozoic age, including basalt, diabase, and porphyrite. The minerals of the igneous rocks are all described in great detail, and numerous optical, X-ray, chemical, and other data are usually provided. Of particular interest are the native iron, native copper, graphite, and diamond which are found in basalt. Other described minerals include various sulphide and oxide minerals, feldspars, zeolites, zircon, epidote, allanite, micas, pyroxenes, chlorites, clay minerals, palygorskite, several phosphates, carbonates, and also palagonite and the products of devitrification of volcanic glass. The genesis of all the minerals is discussed in detail, and processes of autometamorphism, metasomatism, hydrothermal activity, and weathering are described. S. I. T.

Zoubek (V.), scientific editor ; Buday (T.), Kodym (O., *sen.*), Mahel (M.), Máška (M.), Matějka (A.), & Svoboda (J.). *Tectonic development of Czechoslovakia*. Prague (Publ. House Czechosl. Acad. Sci.), 1960. 262 pp., 21 illustr., tectonic map 1 : 1 000 000. Kčs 36.50.

Since the processes of concentration of minerals, and especially of ore minerals, are closely related to the tectonic structures of the region, this publication is important to mineralogists and geochemists. J. N.

Mitchell (G. H.), Walton (E. K.), & Grant (D.), editors. *Edinburgh geology : an excursion guide*. Edinburgh & London (Oliver & Boyd), 1960, xv + 222 pp., 25 figs., 8 pls. Price 12s. 6d.

Includes brief details of the Arthur's Seat volcanics, the Lower Carboniferous igneous rocks of East Lothian, the riebeckite-felsite and sanidine-trachyte of the Eildon Hills, the Pb-Zn deposits of the Leadhills district, and the Lower Old Red Sandstone lavas and associated intrusive rocks of the Pentland and Ochil Hills. R. A. H.

AILEY (E. B.) & MAUFE (H. B.), with contributions by C. T. CLOUGH, J. S. GRANT WILSON, G. W. GRABHAM, H. KYNASTON, W. B. WRIGHT. 2nd (revised) edition by E. B. BAILEY with economic chapter by T. R. M. LAWRIE. *The Geology of Ben Nevis and Glen Coe and the surrounding country* (Explanation of Sheet 53). Mem. Geol. Survey, Scotland. Edinburgh (H.M. Stationery Office), 1960, 307 pp., 41 figs., 13 pls. Price 35s.

A fully revised description of a classic metamorphic and neous area in the western Highlands of Scotland. The ost important aspects of the geology are the recumbent lding of the schists, the cauldron subsidences of Glen Coe nd Ben Nevis, and the wide range of Lower Old Red ndstone igneous rocks. The type localities of appinite nd kentallenite are in this area, and withamite was first scovered there. P. A. S.

HEMISTER (J.). *British Regional Geology. Scotland : The Northern Highlands.* 3rd edition. London (H.M. Stationery Office), 1960, vii + 104 pp., 27 figs., 8 pls. Price 5s. R. A. H.

HRENS (L. H.), PRESS (F.), RANKAMA (K.), & RUNCORN (S. K.), editors. *Physics and chemistry of the earth, vol.* IV. London & New York (Pergamon), 1961, 320 pp. Price 70s., $10.00. R. A. H.

ZAROFF (LEONID V.) & BUERGER (MARTIN J.). *The powder method in X-ray crystallography.* New York (McGraw-Hill), 1958, xv + 342 pp.

Reviewed by G. Faust in A.M. **45**–248. A. C. H.

ÖRNER (RUDOLF). *Welcher Stein ist das?* Stuttgart (Franckh'sche Verlag.), 1958, 176 pp., 183 figs., 14 coloured pls. Price DM. 7.20. R. A. H.

ENNEN (WILLIAM H.). *Principles of mineralogy.* New York (The Ronald Press Company), 1959, v + 429 pp. Price $7.50.

Reviewed A.M. **45**–246 by A. Pabst. A. C. H.

ARKER (ALFRED). *Petrology for students.* 8th edition, revised by C. E. TILLEY, S. R. NOCKOLDS, & M. BLACK. Cambridge (University Press), 1960, 283 pp., 99 figs. Price 15s., paper-bound. R. A. H.

HENRY (N. F. M.), LIPSON (H.), & WOOSTER (W. A.). *The interpretation of X-ray diffraction photographs.* 2nd edition. London (Macmillan), 1960, vi + 282 pp., 249 figs., 13 tables. Price £3 3s.

[M.A. **11**–357] R. A. H.

DE JONG (W. F.). *General crystallography : a brief compendium.* London & San Francisco (W. H. Freeman), 1960, x + 281 pp., 231 figs. Price 38s., $6.00.

Reviewed M.M. **32**–741 by E. F. Stumpfl. R. E. W.

KRINOV (E. L.). *Principles of meteoritics.* London & New York (Pergamon), 1961, 540 pp. Price 70s., $12.00. R. A. H.

RILEY (CHARLES M.). *Our mineral resources.* New York, (John Wiley & Sons, Inc.), 1959, x + 338 pp., 102 figs. Price $6.95.

Reviewed by W. A. Kneller in A.M. **45**–250. A. C. H.

RUSSELL (R. D.) & FARQUHAR (R. M.). *Lead isotopes in geology.* New York & London (Interscience Publishers), 1960, viii + 243 pp. Price 65s., $9.00. R. A. H.

SHUBNIKOV (A. V.) & SHEFTAL (N. N.), editors. *Growth of crystals,* vol. 2 (*translated from the Russian*). New York (Consultants Bureau), 1959, 180 pp., 189 figs. Price $16.00.

[M.A. **14**–241]. R. A. H.

SMITS (D. W.), editor. *World directory of crystallographers and of other scientific officers employing crystallographic methods.* 2nd edition. Utrecht (published for the Intern. Union Cryst. by N. V. A. Ooshoek), 1960, 134 pp. Price U.S. $1.50.

Reviewed M.M. **32**–672 by G. F. Claringbull.

SWINEFORD (A.), editor. *Clays and clay minerals : Eighth National Conference.* London & New York (Pergamon), 1961, 350 pp. Price 63s., $9.50. R. A. H.

CLAY MINERALS

Techniques : structure : properties

HINCKLEY (DAVID N.) & BATES (THOMAS F.). *An X-ray fluorescence method for the quantitative determination of small amounts of montmorillonite in kaolin clays.* Amer. Min., 1960, **45**, 239–241, 1 fig.

The method utilizes the difference in base exchange capacity between kaolinite and montmorillonite. The procedure consists of exchanging the Sr^{2+} ion into the montmorillonite, dialysing out the excess strontium, and then analysing the exchanged sample for Sr by X-ray fluorescence. A. C. H.

Mackenzie (R. C.). [*The evaluation of clay mineral composition with particular reference to smectites. I.* Silicates Industr., 1960, **25**, 12.] Brit. Ceram. Abstr., 1960, abstr. 1815.

A technique is described whereby not only can the ionic formula of a smectite be deduced from the chemical analysis of an impure sample, but the mineralogical constitution of the sample may also be derived with reasonable accuracy. The information required is : (1) a chemical analysis of the sample saturated with a known cation (e.g., Ca^{2+}) ; (2) the c.e.c. of the sample ; (3) the amounts of free oxides present ; (4) a limited amount of mineralogical data (e.g., X-ray data). Application of the method of Osthaus for determination of octahedral and tetrahedral Fe and Al may give added precision. The technique is illustrated by application to 7 smectitic clays ; suitably modified it could be applied to any groups of clay minerals. A. G. C.

Carroll (Dorothy). *Carbon dioxide and alumina in the potentiometric titration of H-montmorillonite.* Prof. Paper U.S. Geol. Survey, 1960, **400B**, B436–438. K. S.

Thomson (T. R.). [*X-ray examination of clay minerals in shales.* B.H.P. Tech. Bull., 1959, **3**, no. 2, 20, 3 figs.] Brit. Ceram. Abstr., 1960, abstr. 1493.

By preparing an 'oriented aggregate' sample for X-ray examination more intense basal reflections can be obtained, with resulting greater sensitivity in detection and accuracy in intepretation. Techniques for preparing the sample are described. Methods of differentiating between certain clay minerals are given ; work on correlation of chemical analysis and quantitative X-ray diffraction data is in progress. A. G. C.

[Frank-Kamenetskiĭ (V. A.)] Франк-Каменецкий (В. А.). По поводу широких колебаний состава глинистых минералов (Изоморфные замещения и смешанно-слоистые срастания среди минералов глин) [*On the subject of wide variability of the composition of clay minerals* (*Isomorphic substitutions and mixed-layer intergrowths among the clay minerals*)]. Минер. Сборник Львовского Геол. Общ. [Min. Mag. Lvov Geol. Soc.], 1958, **12**, 144–147, 1 fig. [English summary.]

The title and sub-title of this paper fully indicate its contents. S. I. T.

Freund (F.). *Eine neue Deutung der exothermen Reaktion des Kaolinits zwischen* 950 *bis* 1000°*C.* Naturwiss., 1959, **46**, 375–376.

The reaction is considered to be due to lattice collaps and not to the heat of crystallization of phases such a γ-Al_2O_3, etc. A. G. C.

Holdridge (D. A.). [*Isomorphous replacements in kaolinite* Brit. Ceram. Res. Assoc. 1959. 'The A.T. Green Book' p. 30.] Brit. Ceram. Abstr., 1960, abstr. 1096.

Evidence indicates the probability of isomorphou replacements of Al^{3+} by Fe^{3+} & Mg^{2+} in the octahedra layer of the kaolinite lattice. A. G. C.

Quirk (J. P.). *Negative and positive adsorption of chlorid by kaolinite.* Nature, 1960, **188**, 253–254, 2 figs. M. J. Le B.

Wada (Koji). *An interlayer complex of halloysite wit ammonium chloride.* Amer. Min., 1959, **44**, 1237–1247 6 figs.

Samples of hydrated halloysite from Yoake, Oita, Japan were treated with NH_4Cl solutions or dry-ground wit NH_4Cl crystals. On treatment the 001 and 003 reflection changed from 10·1 and 3·36Å to 10·5 and 3·49Å respec tively. Two molecules of interlayer water are replaced b one NH_4Cl molecule ; orientation studies show that tw molecules of NH_4Cl per halloysite unit cell are adsorbed this corresponds to 325 to 330 m.mols per 100 g of air-drie clay. The treated clay shows a lack of normal NH_4C X-ray reflections, loss of the 185°C NH_4Cl α–β trans formation, and a rise of 30 to 50°C in decompositio temperatures. B. H. B.

van der Marel (H. W.) & Zwiers (J. H. L.). [Stretchin O–H bonds of the kaolin minerals. Silicates Industr 1959, **24**, 359, 8 figs.] Brit. Ceram. Abstr., 1960, abst 228.

The stretching O–H bonds of the Al-, the Mg- and th Fe-kaolins were studied by infrared spectrophotometr using the high resolving power of a CaF_2 prism and applyin the KBr pressed disc technique for the samples. Th frequency values found were correlated with the site of th O–H groups in the crystal lattices, i.e., with their differen degrees of H-bonding to surrounding O atoms and with th kind of element (Si, Al, Mg, Fe) to which these O–H group are bonded. Thus four stretching O–H bonds were foun for the well-ordered Al kaolins (kaolinite, dickite, an nacrite) which are associated with the four different site of O–H groups which should exist in their crystal structure as suggested by Gruner. The intensity and the shape of th bonds are affected by the degree of crystallinity and in th case of free O–H groups, also by the surface of the minera concerned. A. G. C.

EY (R.). [*The mechanism of the adsorption of anions by montmorillonite.* Silicates Industr., 1959, **24**, 376, 8 figs.] Brit. Ceram. Abstr., 1960, abstr. 237.

The adsorption of anions is not at all comparable with e adsorption of cations, but depends on the nature of the ion and also on the pH and the presence of exchangeable tions. Some examples are considered. A. G. C.

IPIAT (J. J.), CHAUSSIDON (J.), & TOUILLAUX (R.). *Study of dehydration of montmorillonite and vermiculite by infrared spectroscopy.* Journ. Phys. Chem., 1960, **64**, 1234–1241, 7 figs.

Correlation of basal spacing, as determined by X-ray ffraction, with adsorption bands due to O–H vibration and gular vibration in water, at various temperatures up to 0°C show that (1) water molecules remain up to final hydration even after collapse of the interlayer space, and) lattice dehydroxylation starts before dehydration is mplete. There is a long theoretical discussion.

W. T. H.

CATEE (J. L., *Jr.*) & CONCILIO (C. B.). *Effect of heat on an organo-montmorillonite complex.* Amer. Min., 1959, **44**, 1219–1229, 9 figs.

A complex of montmorillonite plates separated by four yers of dimethyldioctadecylammonium chloride exists at om temperature. On heating to 180°C the basal spacing pands reversibly from about 28 to 32Å. Further heating m 200 to 600°C causes sudden collapse to a one-layer stem with basal spacing 14·5 to 13·0Å ; beyond 600°C the ttice collapses to 9·8Å. No significant differences were bserved between samples heated in atmospheres of air, ygen, and nitrogen. B. H. B.

CATEE (J. L., *Jr.*). *Inorganic-organic cation exchange on montmorillonite.* Amer. Min., 1959, **44**, 1230–1236, 7 figs.

The base exchange relationships of sodium-treated ntrifuged Wyoming bentonite with amine, amine salts, d quaternary salts were tested. The sodium in mont- orillonite is replaced by organic salts stoichiometrically a limit, but greater than stoichiometric amounts of ganic salts are required to replace calcium and mag- sium. Exchangeable hectorite cations are more easily placed by an organic salt than are those of Wyoming ntonite. B. H. B.

ATO (T.). *Transformation from bayerite to hydrargillite.* Naturwiss., 1959, **46**, 376, 1 fig.

The transformation rate for the conversion of bayerite hydrargillite in water or alkali solutions is small ; the esence of alkalis does, however, promote the trans- rmation. [M.A. **6**–350] R. A. H.

UKAI (YASUO), NISHIMURA (SHIN'ICHI), & YOKOI (TOSHIO). *On the uranium exchange of clay minerals.* Mem. Coll. Sci., Univ. Kyoto, ser. B, 1958, **24**, 353–357, 1 fig., 3 tables.

The total exchange capacities of kaolinite from Naegi, illite from Matsushiro, and montmorillonite from Hojun are 9·1, 22·0, and 65·1 me./100 g. respectively. The ability of these clays when K-saturated to exchange for Na^+, Ca^{2+}, Zn^{2+}, Fe^{3+}, U^{6+}, and Th^{4+} from chloride and from sulphate solution has been determined. In terms of mass the greatest exchange in each cases is by Th^{4+}, followed by U^{6+}. A. P.

KATO (C.). [*D.t.a. of clay minerals between temperatures of 0° & −195°C.* Yogyo Kyokai Shi, 1959, **67**, 243, 3 figs.] Brit. Ceram. Abstr., 1960, abstr. 489.

A. G. C.

CARROLL (DOROTHY) & POMMER (ALFRED M.). *Acidic properties of Fithian 'illite'.* Prof. Paper U.S. Geol. Survey, 1960, **400B**, B434–436. K. S.

BLACKMON (PAUL D.). *Neutralization curves and the formulation of monovalent cation exchange properties of clay minerals.* Amer. Journ. Sci., 1958, **256**, 733–743, 9 figs.

Exchange constants are derived for three clay materials, a beidellite, an 'illite', and a bentonite. Assuming the existence of two exchange sites, C^- and E^-, the titration curves for the three materials, using potassium, ammonium and sodium hydroxides, are interpreted. Differences in the bonding strength of hydrogen to the two sites compared with the other three cations are discussed. Hydrogen appears to have a 'preference' for the E^- site whereas the other three cations show a slightly greater bonding strength to the C^- site. It is considered probable that the three cations replace each other in these clay materials more readily than any one of them replaces hydrogen.

R. M. B.

Petrology

KEELING (P. S.). [*The mineralogical examination of clays.* Trans. 6th Intern. Ceram. Congr., 1958, 195 pp., 10 figs.] Brit. Ceram. Abstr., 1960, abstr. 1810.

More than 600 clays from many different geological formations have been investigated. A. G. C.

VAN TASSEL (R.). *Allophane-évansite de Blaton.* Bull. Soc. belge Géol., 1959, **68**, 47–49.

Colourless and faintly yellow or brown, glassy and fluorescent allophane-evansite (n 1·462 to 1·470) is found

associated with halloysite at Blaton, Hainaut, Belgium. Analysis shows Al_2O_3 34·0, SiO_2 17·9, P_2O_5 6·8, ign. loss 40·9, =99·6. [M.A. **14**–391] F. Sch.

Konta (Jiří). [*Clay minerals from the cassiterite-wolframite and molybdenite ore veins in Krupka (Graupen) in Bohemia*]. Acta Univ. Carolinae – Geologica, Praha, 1960, no. 1, 23–50. [Czech with Russian and English summaries.]

Clay minerals from these veins near Krupka (Graupen) in the Krušné Hory (Erzgebirge) were identified under the polarizing microscope and by X-rays and d.t.a.; their densities were determined. Approximate quantitative evaluation was done on the basis of gravimetric thermal analyses. The veins fully filled with clay substance contain mainly three-layer minerals; hydromuscovite always predominates over montmorillonite, kaolinite or dickite is present only in small amount. In this type of clay fissure filling ore minerals do not occur at all or are only accessory. Open veins have on their walls coats of clay material, in which two-layer clay minerals predominate; dickite predominates strongly over kaolinite, and montmorillonite is sometimes also present in small amount. Ore minerals, mainly cassiterite but also native bismuth and in other veins molybdenite, are profuse; quartz and fluorite also are abundant. Well-crystallized, fine-grained muscovite from druse cavities was identified, and replacement of topaz by clay substance with predominating hydromuscovite described. Pseudomorphs of dickite after topaz are fairly rare. J. N.

Glogoczowski (J. J.). *Niektore własności bentonitów i ilów bentonitowych z Chmielnika* [Some properties of bentonites and bentonitic clays from Chmielnik]. Rocz. Pol. Tow. Geol., 1958, **27**, 195–215.

The bentonitic clays from Chmielnik consist mainly of illite and variable amounts of montmorillonite. They are characterized by low capacity of ionic exchange. The shape of thermal curves varies considerably and indicates transition from the primary complex clay minerals (mainly illite) into new as yet not sufficiently known minerals of the montmorillonite group. W. S.

Ryka (W.) & Tomczyk (H.). *Bentonity w osadach staropaleozoicznych gór Świetokrzyskich* [Bentonites in old Palaeozoic sediments from the Swietokrzyskie Mountains]. Kwart. Geol., 1959, **3**, 689–708.

Ordovician and Silurian of the Swietokrzyskie Mountains contain thin bentonitic intercalations. X-ray data, five chemical analyses, and differential thermal analyses are given. The bentonites consist of montmorillonite and illite in varying proportion. Feldspars, biotite, quartz, zircon, and apatite are present as phenocrysts; relic ash texture, brecciated and reticulated structures are described. The parent material ranged in composition from trachyte to latite. W. S.

Kozlowski (S.) & Parachowiak (W.). *Produkty wietrzenia basaltów w rejonie Lubania na Dolnym Ślasku* [Weathering products of basalts near Luban, Lower Silesia]. Acta Geol. Pol., 1960, **10**, 285–323, 4 figs.

Red weathering products of Miocene basaltic lavas are compared with bauxitic weathered basaltic rocks from other parts of the world. Microscopic, chemical, spectrographic, and thermal analyses are given. Clay minerals of the montmorillonite group are present while diaspore (boehmite) and hydrargillite are absent. The type of weathering indicates rather dry climatic conditions and impervious character of the bedrock. W. S.

Vivaldi (J. L. M.) & Vilchez (F. G.). [*Study of the halloysite from Maazza (North Morocco)*. Silicates Industr., 1959, **24**, 380, 8 figs.] Brit. Ceram. Abstr., 1960, abstr. 236.

The main constituent is halloysite ($2H_2O$ & $4H_2O$) with gibbsite in the bottom layers and a montmorillonoid in the top ones. The deposit is of Miocene age (Sahelian) and must be derived from altered acid volcanic rocks of the region. A. G. C.

Ben-Yair (M.). *Studies on the weathering cycles of calcareous rocks in Israel.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **1**, 54–60, 3 figs.

The weathering products of soft and hard calcareous rocks differ in chemical and mineralogical composition. The soft rocks give 30–70% $CaCO_3$ together with montmorillonite as the dominant clay mineral, and lesser illite and kaolinite. The hard rocks give only about 5% $CaCO_3$ but usually have kaolinite as the dominant clay mineral with lesser montmorillonite and illite. The porosity of the softer rocks is responsible for the absorption of leaching solutions, causing the conservation of $CaCO_3$. R. A. H.

Yaalon (D. H.). *Notes on the clay mineralogy of the major soil types of Israel.* Bull. Res. Council Israel, 1955, **5B**, 168–173, 2 tables.

The clay components of the soils examined fall mineralogically into three groups: (1) montmorillonite and illite in varying proportions, kaolinite accessory; (2) kaolinite dominant; (3) palygorskite and montmorillonite. Quartz occurs throughout in traces; goethite, hematite, anatase, feldspar, and chlorite are irregularly distributed; and cristobalite occurs only in the palygorskite group. Only the clays of the basaltic soils, essentially montmorillonite,

nd of the coastal hamra (red sandy loam) are believed to authigenic ; in all other types the clay minerals are erived. M. J. O.

AALON (D. H.). *Clays and some non-carbonate minerals in limestones and associated soils of Israel.* Bull. Res. Council Israel, 1955, **5B**, 161–167, 1 fig.

By considering the insoluble residues of the rock the ay fractions of three soils are shown to be largely inherited nd derived from their underlying limestones. The hard rystalline limestone associated with terra rossa yielded lite and montmorillonite, with kaolinite and inter-ratified minerals accessory. The soft porous limestone nd friable clayey limestone, both associated with rendzina-ke soils, gave mainly palygorskite and montmorillonite. races of cristobalite occur in both, and also in chert and iliceous organic debris in the porous limestone.

M. J. O.

ITRA (R. P.) & RAO (M. V. R.). *Identification of chlorite in Indian clays by X-ray diffraction studies of their oriented aggregates.* Proc. Nat. Inst. Sci. India, 1960, **26A**, 81–85, 2 pls.

Chlorite in soils identified by 'oriented aggregate' tech-ique, was found to be present as such, with illite and aolinite and as interstratified layers. A. P. S.

HAG (A. S.) & KABADI (M. B.). *Differential thermal analysis of Indian china clays.* Journ. Sci. & Industr. Res., India, 1960, **19B**, 224–226, 1 fig.

D.t.a. data on some Indian china clays are given.

A. P. S.

HOUSE (K. M.) & DATAR (D. S.). *X-ray diffraction studies of Indian bleaching earths : Part I—Fullers' earth from Chincholi Taluk (Mysore State).* Journ. Sci. & Industr. Res., 1960, **19B**, 306–309.

X-ray powder diffraction data of some Indian fuller's arths are given, and palygorskite, beidellite, illite and epiolite are reported. A. P. S.

AKAMINE (HIDEO) & NOZAWA (KAZUHISA). *Studies on the deposits of raw materials for ceramics in Aichi and Gifu prefectures, central Japan, with special reference to the genesis.* Japanese Journ. Geol. Geogr., 1955, **26**, 47–59, 5 figs., 2 tables.

Chemical analyses, X-ray diffraction patterns and d.t.a. urves are reported for 8 ceramic clays or clay minerals. The samples examined consist mostly of minerals of the aolin group and are in part derived from granitic rocks and n part from tuffaceous materials. A. P.

TOURTELOT (HARRY A.), SCHULTZ (LEONARD G.), & GILL (JAMES R.). *Stratigraphic variations in mineralogy and chemical composition of the Pierre shale in South Dakota and adjacent parts of North Dakota, Nebraska, Wyoming, and Montana.* Prof. Paper U.S. Geol. Survey, 1960, **400B**, B447–452.

Most samples of Pierre shale consist of 65 to 80% clay minerals, 15 to 25% quartz, a few per cent feldspar, and commonly small amounts of calcite, dolomite, biotite, pyrite, gypsum, jarosite, clinoptilolite, and organic matter. The clay mineral fraction typically consists of 25 to 45% montmorillonite, 35 to 45% mixed-layer illite-montmorillonite, 15 to 25% illite, and about 5% each of kaolinite and chlorite. K. S.

SMOOT (T. W.). *Clay mineralogy of pre-Pennsylvanian sandstones and shales of the Illinois basin. Part I—Relation of permeability to clay mineral suites.* Circ. Illinois State Geol. Survey, 1960, **286**, 20 pp., 8 figs., 5 tables.

110 samples have been investigated. The clay minerals of the permeable sandstone are characterized by heterogeneous mixtures of degraded illite, chlorite, kaolinite, and montmorillonite. The shales are characterized by well crystallized illite and chlorite, minor amounts of degraded illite and chlorite, with traces of kaolinite. The clay minerals of the shales and sandstones had the same source ; heterogeneity in the suites in the sandstones was caused by degradation (after lithification) by circulating fluids. The low permeability of the shales prevented such circulation.

W. A. WH.

SMOOT (T. W.) & NARAIN (K.). *Clay mineralogy of pre-Pennsylvanian sandstones and shales of Illinois basin. Part II—Clay mineral variations between oil-bearing and non-oil bearing sandstones.* Circ. Illinois State Geol. Survey, 1960, **287**, 14 pp., 4 figs., 2 tables.

Kaolinite and chlorite tend to be higher, illite lower, in the oil-bearing sands. W. A. WH.

SMOOT (T. W.). *Clay mineralogy of pre-Pennsylvanian sandstones and shales of the Illinois basin. Part III—Clay mineralogy of various facies of some Chester sandstones.* Circ. Illinois State Geol. Survey, 1960, **293**, 19 pp., 5 figs.

The shales and sandstones had a high and a low kaolinite facies ; the former represents sediments deposited near shore whereas the low kaolinite facies represents sediments deposited further from shore. W. A. WH.

WHITE (W. A.). *Lightweight aggregate from Illinois shales.* Circ. Illinois State Geol. Survey, 1960, **290**, 34 pp., 2 figs., 2 pls., 2 tables.

Clays and shales from Ordovician through Pleistocene periods were heated to fusion, usually near 1200°C. The shales which contained between 0·3 and 1·0% organic carbon tended to produced the best lightweight aggregate. In shales with insufficient organic carbon, the addition of 1% coal produced the desired bloating. Too much kaolinite and quartz cause shale to be too refractory and therefore uneconomic to bloat. Mineralogical and chemical data are given. W. E. P.

Frye (J. C.), Willman (H. B.), & Glass (H. D.). *Gumbotil, accretion-gley, and the weathering profile.* Circ. Illinois State Geol. Survey, 1960, **295**, 39 pp., 5 figs., 5 tables.

Heavy mineral, feldspar, quartz, and clay mineral data and the composition of pebbles are given. W. A. Wh.

Lodding (William). *Vermicular gibbsite in the Pensauken of New Jersey.* Amer. Min., 1960, **45**, 228–229, 1 fig.

Vermiforms found in the Pensauken formation of New Jersey were found to be mainly composed of gibbsite. A. C. H.

Cleveland (George B.). *Geology of the Otay bentonite deposit, San Diego County, California.* Spec. Rept. California Divn. of Mines, 1960, **64**, 16 pp.

Bentonite occurs in six or more beds of Pliocene age; reserves are more than 8·5 million tons. The bentonite has a high base-exchange capacity, hence is used as a decolorizer in refining petroleum products. A compilation lists previously published data, including six chemical analyses; the Otay clay is one of the reference standards of American Petroleum Institute Project 49 [M.A. **3**–72, 143, **10**–26, **11**–169, **14**–249]. K. S.

Various

Žemlička (J.). [*The geochemistry of the underlying titanium clays of the northern Bohemian Brown-coal- and Sokolov basins.*] Publ. House Czechosl. Acad. Sci., Prague, 1960, 52 pp. [In Czech].

The paper presents as the main problem from the geochemical point of view the genesis of the titanium clays of the northern Bohemian Brown-coal and Sokolov basins. The conclusions and the discussion of the genesis and geochemistry of the underlying titanium clays are based on chemical, spectral, and mineralogical analyses and laboratory experiments, on photographs made by electron microscope, and on experiments on disintegration of the clays. J. N.

Neumann (R.). [*The genesis of the red kaolins of Central Germany.* Silikattechnik, 1960, **11**, 56, 4 figs.] Brit. Ceram. Abstr., 1960, abstr. 1816. A. G. C.

Roy (Rustum) & Mumpton (Frederick A.). *Weathering studies: 2. A note on the conversion of phlogopite to septechlorite.* Journ. Geol., 1958, **66**, 324–326.

Examination of a partly weathered single crystal of low iron phlogopite shows the only weathering product to be a two-layer clay mineral of the 'septechlorite' [M.A. **14**–465] or antigorite type. Electron microscopic observation shows the absence of epitaxial relations between the two phases. Iron-free phlogopites weather, in a manner analogous to muscovites, to a two-layer clay mineral, whereas the ferruginous trioctahedral micas appear to weather to vermiculites. H. L.

[Antipov-Karataev (I. N.) & Kader (G. M.)] Антипов-Каратаев (И. Н.) и Кадер (Г. М.). Опыт экспериментального изучения процессов гидролиза первичных минералов и образования вторичных глинистых минералов [*An attempt at an experimental study of the processes of hydrolysis of primary minerals and the formation of secondary clay minerals*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. tech. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, 159–165.

Adularia feldspar, orthoclase, albite, labradorite, muscovite, and biotite were hydrolysed (1) by the method of electrodialysis, and (2) by leaching in the Soxhlet extraction apparatus. The first method did not provide any evidence of the formation of secondary clay minerals from feldspars but hydromicas were produced from micas. The second method provided indirect evidence of the synthetic formation of clay minerals. S. I. T.

Swineford (Ada), editor. *Clays and clay minerals.* Proc. 4th Conf. Clays and Clay Min., Nat. Acad. Sci., Nat. Res. Council, Washington, 1956, Publ. 456, 444 pp., 180 figs., 62 tables. Price $6.00.

Forty-seven papers presented at the 4th National Clay Conference held at The Pennsylvania State University, University Park, Pa., October 10–13, 1955.

Griffiths (J. C.), Bates (T. F.), & Shadle (H. W.). *Guide to field trip of fourth National Clay Conference: clay minerals in sedimentary rocks.* 6 figs. (pp. 1–20).

Kinter (E. B.) & Diamond (Sidney). *A new method for preparation and treatment of oriented aggregate specimens of soil clays for X-ray diffraction analysis.* Abstract only (p. 21).

Milne (I. H.) & Warshaw (C. M.). *Methods of preparation and control of clay mineral specimens in X-ray diffraction analysis.* 7 figs. (pp. 22–30).

Murray (H. H.) & Lyons (S. C.). *Correlation of paper-coating quality with degree of crystal perfection of kaolinite.* 8 figs. (pp. 31–40).

Bradley (W. F.). *The green compression strength of natural bentonites.* 1 fig. (pp. 41–44).

Hauser (E. A.). *The colloid science of silica and silicones.* 5 figs. (pp. 45–53).

Hénin (S.). *Synthesis of clay minerals at low temperatures.* 3 figs. (pp. 54–60).

Brindley (G. W.) & Comer (J. J.). *The structure and morphology of a kaolin clay from Les Eyzies (France).* 2 figs. (pp. 61–66).

Sudo (Toshio) & Takahashi (Hiroshio). *Shapes of halloysite particles in Japanese clays.* 5 figs. (pp. 67–79).

Zussman (J.). *Recent X-ray structural work on serpentine minerals.* (Pp. 80–81.)

Roy (Della M.) & Roy (Rustum). *Hydrogen-deuterium exchange in clays and problems in the assignment of infrared frequencies in the hydroxyl region.* (Pp. 82–84.)

Rowland (R. A.), Weiss (E. J.), & Bradley (W. F.). *Dehydration of monoionic montmorillonites.* 5 figs. (pp. 85–95).

Sand (L. B.) & Crowley (M. S.). *Comparison of a natural bentonite with its synthetic analogue.* 1 fig. (pp. 96–100).

Walker (G. F.). *The mechanism of dehydration of Mg-vermiculite.* 7 figs. (pp. 101–115).

Nelson (B. W.). *The illites from northern Ohio shales.* 3 figs. (pp. 116–124).

Roy (Rustum) & Brindley (G. W.). *A study of the hydrothermal reconstitution of the kaolin minerals.* 5 figs. (pp. 125–132).

White (J. L.). *Reactions of molten salts with layer-lattice silicates.* 10 figs. (pp. 133–146).

Albareda (J. M.). *Spanish investigations on clay minerals and related minerals.* 2 figs. (pp. 147–157).

Dekeyser (W.). *Clay-mineral research in Belgium* (1945–1955). (Pp. 158–160.)

Hofmann (Ulrich). *Summary of clay-mineral studies in Germany,* 1954 *and* 1955. (Pp. 161–165.)

MacEwan (D. M. C.). *A study of an interstratified illite-montmorillonite clay from Worcestershire, England.* 4 figs. (pp. 166–172).

Martín-Vivaldi (J. L.) & Cano-Ruiz (J.). *Contribution to the study of sepiolite : II. Some considerations regarding the mineralogical formula.* 1 fig. (pp. 173–176).

Martín-Vivaldi (J. L.) & Cano-Ruiz (J.). *Contribution to the study of sepiolite : III. The dehydration process and the types of water molecules.* 1 fig. (pp. 177–180).

Martín-Vivaldi (J. L.), Cano-Ruiz (J.), & Fontbote (J. M.). *The bentonites from the volcanic region of Cabo de Gata (Almería).* 3 figs. (pp. 181–184).

Sudo (Toshio). *Clay mineral work proceeding in Japan.* (pp. 185–195.)

Gaskin (A. J.) & Walker (G. F.). *Clay mineral research in Australia.* (pp. 196–203.)

van Olphen (H.). *Forces between suspended bentonite particles.* 10 figs. (pp. 204–224).

Oakes (D. T.) & Burcik (E. J.). *Electrokinetic phenomena in colloidal clays.* 8 figs. (pp. 225–239).

Wood (W. H.), Grandquist (W. T.), & Krieger (I. M.). *Viscosity studies on dilute clay mineral suspensions.* 8 figs. (pp. 240–250).

Ormsby (W. C.), Witucki (R. M.), & Weyl (W. A.). *Effect of wetting agents on the deformation behaviour of kaolinite-water systems.* 18 figs. (pp. 251–272).

Hofmann (Ulrich), Weiss (Armin), Koch (G.), Mehler (A.), & Scholz (A.). *Intracrystalline swelling, cation exchange, and anion exchange of minerals of the montmorillonite group and of kaolinite.* 11 figs. (pp. 273–287).

Marshall (C. E.). *Thermodynamic, quasithermodynamic, and non-thermodynamic methods as applied to the electrochemistry of clays.* 4 figs. (pp. 288–300).

Osthaus (Bernard). *Kinetic studies on montmorillonites and nontronite by the acid-dissolution technique.* 11 figs. (pp. 301–321).

Kerr (G. T.), Zimmerman (R. H.), Fox (H. A., *Jr.*), & Wells (F. H.). *Degradation of hectorite by hydrogen ion.* 3 figs. (pp. 322–329).

Brindley (G. W.) & Radoslovich (E. W.). *X-ray studies of the alteration of soda feldspar.* (pp. 330–336.)

Mumpton (F. A.) & Roy (Rustom). *The influence of ionic substitution on the hydrothermal stability of montmorillonoids.* Abstract only (pp. 337–339).

Murray (H. H.) & Leininger (R. K.). *Effect of weathering on clay minerals.* 5 figs. (pp. 340–347).

Tooker (E. W.). *Altered wall rocks along vein deposits in the Central City-Idaho Springs region, Colorado.* 4 figs. (pp. 348–361).

Whittig (L. D.) & Jackson (M. L.). *Mineral content and distribution as indexes of weathering in the Omega and Ahmeek soils of northern Wisconsin.* (pp. 362–371.)

Dekeyser (W.). *Clay minerals research at Ghent University.* 2 figs. (pp. 372–380).

Earley (J. W.) & Milne (I. H.). *Regularly interstratified montmorillonite-chlorite in basalt.* 1 fig. (pp. 381–384).

Weaver (C. E.). *The distribution and identification of mixed-layer clays in sedimentary rocks.* Abstract only, 1 fig. (pp. 385–386).

Hathaway (J. C.). *Mixed-layered structures in vanadium clays.* Abstract only (pp. 387–388).

Sudo (Toshio) & Hayashi (Hisato). *Types of mixed-layer minerals from Japan.* 7 figs. (pp. 389–412).

Tamura (Tsuneo). *Weathering of mixed-layer clays in soils.* 3 figs. (pp. 413–422).

Schmehl (W. R.) & Jackson (M. L.). *Interstratification of layer silicates in two soil clays.* 1 fig. (pp. 423–428).

Heystek (H.). *Vermiculite as a member in mixed-layer minerals.* 3 figs. (pp. 429–434).

D. C.

CRYSTAL STRUCTURE OF MINERALS

Bragg (Lawrence). *Achievements in X-ray crystallography.* Proc. Koninklijke Nederlandse Akad. van Wetenschappen, 1960, ser. B., **63**, no. 3, 210–220, 6 figs.

A general view is given of the results obtained by X-ray analysis in the past, as well as what may be attained in future. P. C. Z.

Babuška (I.) & Vitásek (E.). *Some applications of the discrete Fourier transform to problems of crystal lattice deformation. Parts I & II.* Czech. Journ. Phys., 1960, **B10**, 419–427, 488–504. [English with Russian summary.]

The theory of the discrete Fourier transform is applied in solving a system of difference equations describing the positions of atoms in a deformed crystal lattice. The crystal lattice is approximated by the Born-Kármán model modified to include the internal energy of the undeformed crystal. The method elaborated in Part I is applied to the solution of some problems for a plane lattice and the linear chain. The method can be used to investigate deformations around crystal lattice defects. [Authors' summary.]

J. N.

Hoppe (W.). *Fouriertransformierten-Projektionen zur Bestimmung der Struktur planarer Gruppen in Kristallen.* Zeits. Krist., 1960, **114**, 156–159.

The usefulness of projections of the weighted reciprocal lattice for the structural determination of plane groups in crystals is demonstrated. R. A. H.

Bond (W. L.). *Precision lattice constant determination.* Acta Cryst., 1960, **13**, 814–818, 6 figs.

Description of an instrument and technique for precision determination of lattice constants of a single crystal [see following abstracts]. J. Z.

Parrish (W.). *Results of the I. U. Cr. precision lattice-parameter project.* Acta Cryst., 1960, **13**, 838–850, 4 figs.

A comparison of the results of lattice parameter determinations on three standard substances by workers in various laboratories. J. Z.

Parrish (W.), editor. *The precision determination of lattice parameters.* Acta Cryst., 1960, **13**, 818.

A conference on this subject was held in Stockholm 9th–12th June, 1959, by the Commission on Crystallographic Apparatus, International Union of Crystallography. Eight of the papers presented were published as a group as follows :

Straumanis (M. E.). *Some sources of error in precision determination of lattice parameters.* Acta Cryst., 1960, **13**, 818–821, 4 figs.

Weyerer (H.). *Discussion of error in lattice-parameter measurements.* Acta Cryst., 1960, **13**, 821–823, 2 figs.

Černohorský (M.). *The ratio method for absolute measurements of lattice parameters with cylindrical cameras.* Acta Cryst., 1960, **13**, 823–826, 2 figs.

Wilkens (M.). *Zur Brechungskorrektur bei Gitterkonstantenmessungen au Pulverpräparaten.* Acta Cryst., 1960, **13**, 826–828, 3 figs.

Mueller (M. H.), Heaton (L.), & Miller (K. T.). *Determination of lattice parameters with the aid of a computer.* Acta Cryst., 1960, **13**, 828–829, 1 fig.

Barth (H.). *Möglichkeiten der Präzionsgitterkonstantenmessung mit hochmonochromatischer Röntgen-Strahlung.* Acta Cryst., 1960, **13**, 830–832, 6 figs.

Čermák (J.). *The intensity distribution in the focus of curved-crystal monochromators and an estimate of its influence on precision measurements of lattice parameters.* Acta Cryst., 1960, **13**, 832–835, 4 figs.

de Wolff (P. M.). *Diffractometer measurement of low order powder reflections.* Acta Cryst., 1960, **13**, 835–837, 3 figs. J. Z.

OELL (RICHARD R.) & ALTENHOFEN (ROBERT E.). *Preparation of an accurate equal-area projection.* Prof. Paper U.S. Geol. Survey, 1960, **400B**, B427–429.

K. S.

ELOV (N. V.), BORISOV (S. V.), & GOLOVACHEV (V. P.). *On the arbitrarily chosen signs in direct methods for solving crystal structures.* Proc. Nat. Inst. Sci. India, 1959, **25A**, 220–229.

Discusses and tabulates limitations regarding the bitrary choice of three structure amplitudes, introduced the utilization of another symmetry, besides the version. A. P. S.

OLTAI (TIBOR). *Simple technique for the construction of polyhedral structure models.* Amer. Min., 1959, **44**, 1311–1313.

Details are given for the construction of tetrahedra from etate sheet. Ways to fix these polyhedra together and a support are described. B. H. B.

MITH (DEANE K.). *A simple centering jig and goniometer for punching or drilling spheres for structure models.* Amer. Min., 1960, **45**, 717–725, 5 figs.

The construction of a goniometer which allows drilling heres in any irregular coordination is described. Only ne bond angles need be known. A. C. H.

RISHNAN (R. S.), CHANDRASEKHARAN (V.), & RAJAGOPAL (E. S.). *Elastic behaviour of diamond.* Proc. Nat. Inst. Sci. India, 1960, **26A**, 311–319.

A discussion of the elastic behaviour of the diamond ttice, and the nature and magnitude of inter-lattice isplacements. New data support the new 45 constant neory of crystal elasticity. A. P. S.

ELLNER (E.). *A structural scheme for sulfide minerals.* Journ. Geol., 1958, **66**, 503–525, 20 figs., 1 table.

The author proposes a structural scheme for sulfides and lfosalts based on the concept that most of the structures an be considered as distorted close-packed sulfur atoms ith metal in the tetrahedral and octahedral holes. The ructures are classified on the basis of a 'formula factor' ased on the elements involved, and on a 'structure riterion' which gives a value for the portion of a galena-ype structure in the total unit cell. The structures of a umber of sulfides and sulfosalts are discussed in their elation to the proposed classification. H. L.

AYLOR (C. A.) & UNDERWOOD (F. A.). *A twinning interpretation of 'superlattice' reflections in X-ray photographs of synthetic klockmannite, CuSe.* Acta Cryst., 1960, **13**, 361–362, 3 figs.

Previous investigators described klockmannite as hexagonal with a' 3·94, c 17·25Å, ignoring superlattice reflections. The nature of the true cell has now been established as having $a=\sqrt{13}\ a'$, and it is noted that twinning on $(11\bar{2}0)$ gives the effect of a super-cell with $a=13\ a'$. Sub-cell, true cell, and super-cell lattices are all hexagonal with c 17·25Å. A complete determination of the structure (78 CuSe in the true cell) has not yet been achieved. [M.A. **11**–97, **12**–431, **14**–24] J. Z.

ŠĆAVNIČAR (S.). *The crystal structure of stibnite. A redetermination of atomic positions.* Zeits. Krist., 1960, **114**, 85–97, 4 figs.

The crystal structure of stibnite [M.A. **5**–465] is confirmed and a refined set of atomic coordinates given. The structure consists of parallel ribbonlike $(Sb_4S_6)_n$ polymers linked together by the intermolecular attraction between Sb and S atoms at distances of 3·20, 3·33, and 3·60Å. The bonds within the ribbons differ in length due to the two different types of coordination exhibited by both Sb and S. The cell parameters are a 11·25, b 11·33, c 3·84Å, $Z=4$, space group $Pbnm$, D (calc.) 4·61 g/cm³ : synthetic Sb_2S_3 and stibnite from Zajača mine, Yugoslavia, were used.

R. A. H.

MUKHERJEE (B.). *Space group and cell dimensions of a specimen of hollandite.* Acta Cryst., 1960, **13**, 164–165.

Cell parameters of hollandite, $BaFeMn_7O_{16}$, are similar to those found by previous workers [M.A. **11**–238], but b is doubled. Hollandite from Kajlidongri, Central India, is monoclinic $P2_1/n$, with a 10·02, b 5·76, c 9·89Å, β 90°36′, $Z=2$, D 4·92 g/cm³. Chemical analysis by B. D. Sarma gave Al_2O_3 0·50, Fe_2O_3 12·02, MnO 5·44, MnO_2 65·92, BaO 16·08, H_2O nil, =99·96 : numbers of atoms on the basis of 16 oxygens are Al 0·08, Fe^{3+} 1·24, Mn^{2+} 0·63, Mn^{4+} 6·26, Ba 0·87, giving the formula $BaFeMn_7O_{16}$. Hollandite with Al 0·15, Fe^{3+} 1·10, Mn^{2+} 0·60, Mn^{4+} 6·29, Ba 0·96 [Winch, 1909] has a 10·03, b 5·76, c 9·90Å, β 90°42′, D 4·94 g/cm³. J. Z.

HAFNER (S.). *Metalloxyde mit Spinellstruktur.* Schweiz. Min. Petr. Mitt., 1960, **40**, 207–242, 7 figs.

The work is a short description of the spinel structure with special consideration of the possible cation distributions and order-disorder phenomena, as well as a review of recent crystallographic literature. The study was carried out in connection with measurements of infra-red absorption of various metallic oxides showing spinel structures. M. W.

CHRIST (C. L.) & CLARK (JOAN R.). *X-ray crystallography and crystal chemistry of gowerite, $CaO.3B_2O_3.5H_2O$.* Amer. Min., 1960, **45**, 230–234.

Single crystals of gowerite [M.A. **14**–501], studied by X-ray techniques, are monoclinic, belong to space group $P2_1/n$–C_{2h}^5, have a 11·03, b 16·40, c 6·57Å, β 90°56′; $a:b:c=0{\cdot}673:1:0{\cdot}401$; calcd. D $1{\cdot}98_2$ g/cm³ for cell contents $4[CaO.3B_2O_3.5H_2O]$. Indexed X-ray powder date are tabulated. A. C. H.

Embrey (P. G.). *Cahnite from Capo di Bove, Rome.* Min. Mag., 1960, **32**, 666–668.

Cahnite is recorded from a cavity in a dark grey leucitic lava, where it is found on calcite associated with phillipsite and chabazite. X-ray examination showed that the powder pattern is identical with that of cahnite from Franklin, New Jersey [M.A. **3**–365], for which indexed powder data are tabulated. It is suggested that the structure is that of zircon, with Ca occupying Zr positions and alternating $B(OH)_4$ and AsO_4 tetrahedra in the SiO_4 positions. Cell contents are $2[Ca_2B(OH)_4AsO_4]$; a 7·0952, c 6·1904Å; the structure cell has twice the volume of the morphological cell. [M.A. **8**–226, **12**–200] R. A. H.

Gard (J. A.) & Taylor (H. F. W.). *The crystal structure of foshagite.* Acta Cryst., 1960, **13**, 785–793, 6 figs.

The crystal structure of foshagite, $Ca_4Si_3O_9(OH)_2$, has been determined from X-ray fibre rotation photographs. It contains infinite (SiO_3^{2-}) chains similar to those in wollastonite, linked by Ca^{2+} and OH^- ions. The structure was refined from the provisional structure previously suggested by the above authors [M.A. **14**–197]; the present results do not support the alternative structure for foshagite—a 'double chain' structure—suggested by Mamedov and Belov [M.A. **14**–179]. Foshagite crystals show partial stacking disorder, and the factors governing the relative stabilities of different stacking arrangements in this mineral and in wollastonite are discussed. It is found most convenient to refer indices and atomic co-ordinates of the different modifications to a geometrically monoclinic structural element with a 10·32, b 7·36, c 7·04Å, β 106·4°, $Z=2$: multiple values of a and c occur. The true symmetry is triclinic $P\bar{1}$, not monoclinic. The mechanism of dehydration at 700°C is discussed. J. Z.

Gottardi (Glauco). *The crystal structure of perrierite.* Amer. Min., 1960, **45**, 1–14, 3 figs.

The crystal structure of perrierite [M.A. **12**–240, 498] has been determined from X-ray data. The unit cell [M.A. **14**–340] contains two formula units of $(Ce,La,Y,Th,Ca,Na)_4(Fe^{2+},Ca)(Ti,Fe^{3+},Fe^{2+},Mg)_2Ti_2[O_4|(Si,Al)_2O_7]_2$. Perrierite is a sorosilicate with a large number of oxygens not bonded to silicon. Two types of Ti–O octahedral chains occur along the b axis; these chains are connected to give a sheet parallel to (001). Cerium is present in 10-fold, Fe^{2+} in 6-fold coordination with oxygen. Atomic parameters and interatomic distances are given. A. C. H.

Whittaker (E. J. W.). *The crystal chemistry of the amphiboles.* Acta Cryst., 1960, **13**, 291–298, 10 figs.

In the monoclinic amphiboles the parameters β and $a\sin\beta$ (I-centred cell) vary according to the sizes of cations which occur between the $(Si,Al)_4O_{11}$ chains. These relationships are explained in the light of the known structural details, as are also the compositional relationships between monoclinic and orthorhombic amphiboles, and between the different monoclinic amphibole series, tremolite-actinolite, cummingtonite-grunerite, and riebeckite. [M.A. **11**–101, **13**–15, **14**–273] J. Z.

Whittaker (E. J. W.). *Relationships between the crystal chemistry of pyroxenes and amphiboles.* Acta Cryst., 1960, **13**, 741–742.

The relationship between the crystal structure type (monoclinic or orthorhombic) and the sizes of cations is not as well defined in pyroxenes as in amphiboles [preceding abstract]. For both clinopyroxenes and clinoamphiboles, however, a similar trend is noticed in the variation of β with the size of the larger cation present (M_2), and for the clinopyroxenes there is a systematic variation of $a\sin\beta$ with the sizes of the larger and smaller cations (M_2 and M_1). J. Z.

Morimoto (N.), Appleman (D. E.), & Evans (H. T., *Jr.*). *The crystal structures of clinoenstatite and pigeonite.* Zeit. Krist., 1960, **114**, 120–147, 6 figs.

The structures, determined from two-dimensional X-ray diffraction data, are compared with each other and with that of diopside. The introduction of small divalent (Mg, Fe) cations instead of calcium is shown to result in the production of two crystallographically non-equivalent chains in the unit cell with a corresponding change in the space group from $C2/c$ to $P2_1/c$. In ferropigeonite probably all the calcium is in the metal ion position M_I and all the magnesium in M_{II}, while Fe occurs in both sites. In all three structures the larger atoms, where present, occupy M_I positions preferentially. Thus the coordination number of M_I is eight in diopside, seven in pigeonite, and six in clinoenstatite, while the coordination number of M_{II} is six in all three structures. The pigeonite structure appears to be intermediate between those of diopside and clinoenstatite. Analysis of the ferropigeonite investigated, from andesite-dacite dikes near the Asio mine, Japan, gave SiO_2 48·36, TiO_2 0·39, Al_2O_3 0·41, Fe_2O_3 1·36, FeO 32·86, MnO 0·84, MgO 11·34, CaO 4·58, Na_2O tr., K_2O tr., P_2O_5 0·04, H_2O+ 0·15, H_2O- tr., $=100{\cdot}33$: its cell parameters are a 9·731, b 8·953, c 5·256Å, β 108°33′. [M.A. **11**–308, **12**–80, **14**–24] J. Z.

HOSE (SUBRATA) & HELLNER (ERWIN). *The crystal structure of grunerite and observations on the Mg–Fe distribution.* Journ. Geology, 1959, **67**, 691–701.

Least-squares calculations show that Mg and Fe atoms re randomly distributed in three metal positions, and that ost of the fourth position is occupied by Fe. R. E. W.

URLEY (B. J.) & FREEMAN (E. B.). *The effect of temperature on the lattice parameters of quenched synthetic analcime.* Canad. Min., 1959, **6**, 372–379, 2 figs., 1 table.

Analcime synthesized in the presence of water vapour at 5,000 lb/in² and at temperatures between 200°C and 40°C for periods of two to eight days showed no significant ariation in cell edge as expressed by $2\theta_{400}-2\theta_{211}$ (CuKα). his is interpreted as meaning that there is no change in egree of Al–Si ordering with different temperatures of rmation. Three specimens synthesized with excess silica ad slightly larger $2\theta_{400}-2\theta_{211}$ values. R. B. F.

OWELL (P. A.). *A refinement of the cation positions in synthetic zeolite type A.* Acta Cryst., 1960, **13**, 737–741, 2 figs.

The structure of this anhydrous zeolite $Na_{12}(AlO_2)_{12}(SiO_2)_{12}$, space group $Pm3m$, a 12·28Å) had een previously determined [Reed & Breck, Journ. Amer. hem. Soc., 1956, **78**, 5972], but calculation of a Coulombic otential map showed that the assumed Na positions were ot at potential minima. Using the positions of minimum otential as initial Na sites, the structure has been refined y applying the method of least squares to X-ray diffracto- eter traces. Eight Na_I ions near the six-membered oxygen ings randomly occupy 24-fold positions of the space group $Pm3m$) and the four Na_{II} ions near the eight-membered xygen rings randomly occupy another set of 24-fold ositions. For the refined structure $R=0{\cdot}16$ against 0·21 or the former model. It is noted that the a parameter tated above refers to a pseudo cell, the true cell having a 4·56Å. Chemical analysis of the zeolite gave the atom atios Na/Al $0{\cdot}95\pm0{\cdot}04$ and Si/Al $0{\cdot}98\pm0{\cdot}02$, which eviate from those of the ideal formula. [M.A. **15**–119] J. Z.

UELLMER (F. J.). *X-ray intensity measurements on perthitic materials. I. Theoretical considerations.* Journ. Geology, 1959, **67**, 648–660.

X-ray diffractometry should enable determination of elative structural states of the phases in some perthites, sing $\bar{2}01$ peak spacings and intensity ratios, provided the ompositions of the separate phases are outside the range Or_{25} to Or_{85}. Knowing the total composition of the phase ixture, a 'line broadening ratio' is obtained, which dicates the temperature–structural state of the phases. R. E. W.

RADOSLOVICH (E. W.). *The structure of muscovite* $KAl_2(Si_3Al)O_{10}(OH)_2$. Acta Cryst., 1960, **13**, 919–932, 7 figs.

The structure has been refined by bounded two-dimensional projections, and is seen to be considerably distorted as compared with the ideal sheet structure previously assumed. The (Si,Al)–O components of the structure have di-trigonal rather than hexagonal symmetry and occupation of the tetrahedral sites is partially ordered ; half of them are occupied by Si and half by $\frac{1}{2}$Si,$\frac{1}{2}$Al. Potassium atoms are not centrally placed with respect to the holes in adjacent silicate sheets, and are coordinated by six close oxygens (average distance 2·81Å) and six more distant oxygens (average distance 3·39Å). These features are used to explain the observed β angles and polymorphism of muscovite, and lead to some speculations concerning other silicate layer structures. [M.M. **31**–209 ; M.A. **4**–467, **5**–325, **7**–496, **12**–98, 534] J. Z.

MEGAW (H. D.). *Observations on Chayes' discussion of the intermediate plagioclase felspars.* Acta Cryst., 1960, **13**, 564–565.

The displacements, δc, of certain layer lines in oscillation photographs of intermediate plagioclases are observed to be proportional to α, the ratio Si : (Si+Al) [M.M. **31**–21]. Chayes [M.A. **14**–104] is in error in taking δc to be a reciprocal lattice spacing, and no conclusions about order/disorder in feldspars can be drawn from his discussion. J. Z.

NEWNHAM (R. E.) & MEGAW (H. D.). *The crystal structure of celsian (barium felspar).* Acta Cryst., 1960, **13**, 303–312, 3 figs.

Details of the structure have been determined by Fourier difference maps and least squares methods applied to [100] and [111] zone X-ray reflections. The celsian studied is from Broken Hill, New South Wales [M.M. **27**–166], with a formula near $Ba_{0{\cdot}84}K_{0{\cdot}18}Al_{1{\cdot}90}Si_{2{\cdot}11}O_8$. Celsian is monoclinic, $I2/c$, with a 8·627, b 13·045, c 14·408Å, β 115°13′, $Z=8$, D (calc.) 3·26 g/cm³. The structure is similar to that of orthoclase, but ordering of the (Si, Al) atoms is such that the c parameter of the cell is doubled. The (Si,Al) distribution is approximately one in which Si and Al tetrahedra alternate. The Ba atom occupies identical positions in the two sub-cells but has an anisotropic temperature factor. The structure is compared with those of anorthite and potassium feldspars. [M.A. **6**–177, **14**–103] J. Z.

BOUŠKA (VL.), ČECH (FR.), & JOHAN (ZD.). *Study of some Czechoslovak metamict orthites.* Acta Univ. Carolinae–Geologica, Prague, 1960, no. 1, 3–22., [Czech and Russian summaries].

Orthites from pegmatites at Babice near Benešov (Central Bohemia), Chlumek near Měřín (Western Moravia), Vlastějovice-on-Sázava (Eastern Bohemia) and Žulová (Silesia) were studied by X-ray and qualitative spectrographic methods. All are genetically associated with rocks of approximately equivalent geological age. A section deals with their morphological crystallography. The metamict decomposition causes destruction of the crystal lattice which may be partial or complete in consequence of the non-uniform distribution of the radioactive element. Destruction is resisted most in structural planes corresponding to the highest 2θ. After heating the orthite for 4 hours at 800°C several phases appear, one of which corresponds to the original orthite lattice, another to cubic CeO_2; the other phase(s) present could not be identified. J. N.

Kamb (W. B.). *The crystal structure of zunyite.* Acta Cryst., 1960, **13**, 15–24, 6 figs.

The structure proposed by Pauling [M.A. **5**–325] for zunyite has been confirmed and refined using the least squares method on the single crystal X-ray data of [100] and [110] projections. Zunyite, from zunyite-guitermanite rock, Zuñi mine, Silverton, Colorado, is cubic, $F\bar{4}3m$, with a 13·87Å, Z=4, D calc 2·87 g/cm^3. The structure contains Si_5O_{16} groups of linked tetrahedra and $Al_{12}O_{16}(OH)_{30}$ groups of linked aluminium octahedra. The refined structure differs from the earlier model by distortion of coordination polyhedra similar to those found in related structures, e.g., diaspore [M.A. **6**–175]. The average Al–O distance for tetrahedrally coordinated Al is 1·80±0·016Å. The arrangement of protons deduced from structural considerations requires the inclusion of at least two fluorine atoms per formula unit which is consequently given as $(OH,F)_{16}F_2Al_{13}Si_5O_{20}Cl$. J. Z.

Kamb (W. B.). *Accuracy of atomic positions in the zunyite structure.* Acta Cryst., 1960, **13**, 24–27.

The structure determination of zunyite [previous abstract] is used as a test for comparing four methods of estimating the accuracy of atomic parameters. Reliable estimates of standard deviations of ±0·008Å for oxygen and ±0·003Å for silicon and aluminium were obtained. J. Z.

Hauptman (H.), Karle (I. L.), & Karle (J.). *Crystal structure of spurrite, $Ca_5(SiO_4)_2CO_3$. I. Determination by the probability method.* Acta Cryst., 1960, **13**, 451–453, 3 figs.

The direct determination of the phases from the experimental X-ray intensities of spurrite was carried out by means of the probability method, and the structure of spurrite was thereby deduced. The structure is described in the following abstract. [M.A. **14**–104] J. Z.

Smith (J. V.), Karle (I. L.), Hauptman (H.), & Karle (J.). *The crystal structure of spurrite, $Ca_5(SiO_4)_2CO_3$. II. Description of structure.* Acta Cryst., 1960, **13**, 454–458, 7 figs.

Spurrite, from Scawt Hill, Northern Ireland [M.M. **22**–77] is monoclinic $P2_1/a$, with a 10·49, b 6·705, c 14·16Å, β 101°19′, and $Z=4$. The structure consists of isolated SiO_4 tetrahedra and CO_3 equilateral triangles linked together by Ca atoms in an arrangement with pronounced pseudo-orthorhombic symmetry. The CO_3 triangles are perpendicular to b in conformity with b being parallel to the acute negative optical bisectrix. Three of the calcium atoms have seven neighbouring oxygens and the other two have eight. The mean Si–O distance is 1·63Å. The polysynthetic (001) twinning of spurrite results from the pseudo-orthorhombic symmetry, and perfect (001) cleavage follows planes of weakness where the density of Ca–O bonds is relatively low [M.A. **13**–15, 176]. The structure was determined by the probability method of phase determination [see previous abstract]. J. Z.

Jones (D. W.) & Smith (J. A. S.). *Proton magnetic resonance in brushite.* Trans. Faraday Soc., 1960, **56**, 638–647, 5 figs.

Proton magnetic resonance absorption spectra for a single crystal of brushite are interpreted as due to water molecules together with a remote proton. The inter-hydrogen vector of each water molecule makes angles of 50·1° and 40·1° with the a and b axes of the crystal; it has a length of 1·59±0·03Å. The probable position of the phosphate hydrogen in the brushite structure is discussed. [M.A. **7**–89] R. A. H.

Hanson (A. W.). *The crystal structure of eosphorite.* Acta Cryst., 1960, **13**, 384–387, 2 figs.

The structure of eosphorite, $AlPO_4.(Mn,Fe)(OH)_2.H_2O$, was determined by Patterson sections and is described with reference to the orthorhombic space group *Bbam*: it has a 10·52, b 13·60, c 6·97Å, $Z=8$. The structure contains two parallel sets of infinite chains, one composed of $(Mn,Fe)O_4(OH)_2$ octahedra sharing opposite O–O edges and the other of $AlO_2(OH)_2(H_2O)_2$ octahedra sharing opposite H_2O corners. These chains alternate, sharing (OH) corners to form a set of parallel sheets held together by phosphorus ions coordinated tetrahedrally by oxygens. There is evidence that the true structure differs slightly from that described and that its symmetry is pseudo-orthorhombic. [M.A. **10**–538, **11**–407, 426] J. Z.

Fisher (D. Jerome) & Volborth (Alex.). *Morinite, apatite-whitlockite.* Amer. Min., 1960, **45**, 645–667, 4 figs.

Thermal experiments on Black Hills [S. Dakota] morinite, rare fluorophosphate, show that it inverts irreversibly an apatite structure at about 400°C. When heated thin films in air at about 800°C morinite inverts to a nitlockite structure. Several new analyses of morinite nd its decomposition products are given. A. C. H.

RAKI (TAKAHARU). *The crystal structure of linarite, $PbCu(SO_4)(OH)_2$.* Mem. Coll. Sci., Univ. Kyoto, ser. B, 1958, **25**, 69–79, 6 figs., 3 tables.

The lattice constants of linarite from Kisamori are 9·67±0·02, *b* 5·64±0·01, *c* 4·68±0·01Å, β 102°40±15′, pace group $P2_1/m$, $Z=2$. Its structure has been deter-ined from oscillation photographs by means of 2-dimen-onal Patterson, Fourier, and difference syntheses. There re $Cu(OH)_2$ and $PbSO_4$ chains along the *b* axis. Cu atoms re in 4-fold planar coordination. A. P.

RAKI (TAKAHARU). *The crystal structure of wulfenite, $PbMoO_4$.* Mem. Coll. Sci., Univ. Kyoto., ser. B, 1957, **24**, 155–160, 3 figs., 4 tables.

The structure has been redetermined [M.A. **9**–44] using atural crystals from Bolivia ; *a* 5·47±0·01, *c* 12·18±0·02Å ; pace group $I4_1/a$, $Z=4$. Atomic coordinates, determined y 2-dimensional Fourier synthesis, are : Pb 0·0, 0·25, ·625 ; Mo 0·0, 0·25, 0·125 ; O 0·247, 0·342, 0·040. A. P.

OLTAI (T.) & BUERGER (M. J.). *The relative energies of rings of tetrahedra.* Zeits. Krist., 1960, **114**, 1–8, 3 figs.

The shortest loops range from 4 to 6 tetrahedra in coesite, eatite, quartz, cristobalite, and tridymite, and in the licates the shortest loops vary over the same range : here is thus a suggestion that rings of 4 to 6 tetrahedra are ore stable than smaller or larger rings. The energies of eutral rings of *n* tetrahedra ($n=2$ to 100) have been mputed and it is shown that the ring of $n=5$ has the least nergy, with $n=6$ only slightly higher. R. A. H.

TEWARD (E. G.) & COOK (B. P.). *Graphitization in oriented carbons.* Zeits. Krist., 1960, **114**, 245–256, 4 figs.

In a review of knowledge of the crystal structure of poly-rystalline carbons the natural anthracites are discussed. he concept of units larger than those measured by X-ray iffraction must be considered. [M.A. **12**–235, **13**–124] R. A. H.

ELLNER (ERWIN). *An intergrowth between galena and gratonite.* Journ. Geol., 1959, **67**, 473–475.

The departure of 5°–6° from parallelism between the *c*-axis of the gratonite and a [111]-direction of the galena is due to the slight departure of the gratonite from cubic symmetry. R. E. W.

GOLDSMITH (J. R.). *Exsolution of dolomite from calcite.* Journ. Geol., 1960, **68**, 103–109.

The amount of finely divided dolomite in metamorphic calcites may be determined more easily by single crystal X-ray than by the powder method or optically. The oriented intergrowths are regarded as due to a process of exsolution during cooling, similar to that observed in laboratory experiments. Such intergrowths were found in carbonate rocks from 15 world localities, implying that they are of common occurrence. These features are of possible use in geologic thermometry. R. E. W.

GOLDSMITH (JULIAN R.) & GRAF (DONALD L.). *Structural and compositional variations in some natural dolomites.* Journ. Geol., 1958, **66**, 678–693.

Dolomite concentrates from sedimentary rocks ranging in age from Eocene to Ordovician are found to exhibit compositional and structural features similar to those of synthetic protodolomites. They not infrequently contain about 5 mol per cent excess $CaCO_3$ and have weakened order reflections relative to those of 1 : 1 molar $CaCO_3 : MgCO_3$ dolomite. The change in cell size are greater than can be accounted by the $FeCO_3$ and $MnCO_3$ percentages shown in the analyses of 13 of the samples. These structural and compositional features were not observed in metamorphic or hydrothermal dolomites, nor in most samples from evaporite sequences. The decreased intensity of order reflections is interpreted as possibly indicating mixed layering. The $CaCO_3$-rich dolomites lose $CaCO_3$ and approach equilibrium composition if held at high temperature in the presence of a flux. H. L.

RAUP (D. M.). *Crystallography of echinoid calcite.* Journ. Geology, 1959, **67**, 661–674.

The coronal plates of most of the Recent species studied here are single crystals. In 16 species the *c*-axes were found to be perpendicular to the surface and in 25 species to be tangential and oriented meridianally. In 2 species the arrangements were irregular. It would appear that several times in geologic history stocks with a certain orientation quite independently have evolved from those of another orientation. R. E. W.

MASER (MORTON), RICE (ROBERT V.), & KLUG (H. P.). *Chrysotile morphology.* Amer. Min., 1960, **45**, 680–688, 3 figs.

Cross-section electron microscope studies of massive

chrysotile embedded in 'Araldite' showed many sections with rings with central holes. This would indicate a tubular morphology. Photographs of some new arrangements related to tubular crystal growth are given. A. C. H.

Naha (Kshitindramohan). *Optic orientation and crystal symmetry of chloritoid.* Quart. Journ. Geol. Min. Met. Soc. India, 1960, **32**, 11–15, 10 figs.

Details crystallographic data on chloritoid from Eastern India, and infers that the mineral is triclinic and not monoclinic. A. P. S.

Trehan (Y. N.) & Goswami (A.). *Double twinning and crystal orientation.* Proc. Nat. Inst. Sci. India, 1959, **25A**, 210–213.

Indices of newer planes developed parallel to known planes of parent crystal consequent on twinning are deduced from the geometry of twinned crystallites.

A. P. S.

Farquhar (O. C.). *Occurrences and origin of the hourglass structure.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **21**, 194–200, 2 pls.

The occurrences of hourglass structures in diopside, augite, ottrelite, feldspars, selenite, and quartz are reviewed and illustrated. Similar features are reported for colemanite, leucite, brookite [M.M. **23**–126], corundum, leucosphenite, calcite, and chiastolite, while certain anomalous interference figures of garnet and periclase resemble an hourglass. The hourglass structure in synthetic crystals is due to impurities in the solution, which when adsorbed cause habit modifications. This explanation may also apply to natural minerals. The synthesis of hourglass diopsides by the addition of TiO_2 is being attempted.

R. A. H.

Lindberg (Marie Louise). *Crystal habit of frondelite, Sapucaia pegmatite mine, Minas Gerais, Brazil.* Prof. Paper U.S. Geol. Survey, 1960, **400B**, B429–430.

Minute, doubly terminated, stubby crystals of frondelite [M.A. **11**–8], associated with crystals of avelinoite [M.A. **13**–520], metastrengite [phosphosiderite], and leucophosphite [M.A. **14**–56], show {100}, {010}, {110}, and {101}. Space group $B22_12$. Morphological data (calculated) for frondelite—$a : b : c = 0{\cdot}8166 : 1 : 0{\cdot}3063$, $p_0 : q_0 : r_0 = 0{\cdot}3751 : 0{\cdot}3063 : 1$, $q_1 : r_1 : p_1 = 0{\cdot}8166 : 2{\cdot}666 : 1$, $r_2 : p_2 : q_2 = 3{\cdot}265 : 1{\cdot}225 : 1$. K. S.

van Oosterhout (G. W.). *Morphology of synthetic submicroscopic crystals of α and γFeO.OH and of γFe_2O_3 prepared from FeO.OH.* Acta Cryst., 1960, **13**, 932–935, 6 figs.

Selected area electron diffraction shows that the needl axis is [001] for α-FeO.OH (*c* 3·03Å) and γ-FeO.OH (*c* 3·06Å) and [110] for γ-Fe_2O_3 prepared either by dehydration of γ-FeO.OH or by reduction of α-FeO.OH or γFeO.OH followed by oxidation. [M.A. **6**–176, **14**–336] J. Z.

Meyrowitz (Robert) & Lindberg (Marie Louise). *Synthetic bayleyite.* Prof. Paper U.S. Geol. Survey, 1960 **400B**, B440–441.

Unit cell measurements (*a* 26·55, *b* 15·28, *c* 6·50Å, a ±0·5 per cent; β 92°58′±10′) are smaller than thos obtained previously [M.A. **11**–309]. Space group $P2_1/c$ but neither a mirror plane of symmetry nor a two-fold axi of symmetry has been confirmed by crystallographi measurements. Crystals grow in clusters of singly ter minated radiating fibres. Individual crystals are asym metrical in habit; they are tabular parallel to (110) an $(\bar{1}10)$, and the faces (001) and (111), parallel to the sam zone-axis, are well developed. Faces of many forms ar unequally developed. Forms for which angles are tabu lated: *c* {001}, *b* {010}, *a* {100}, *m* {110}, *n* {210}, *g* {021} *h* {401}, *k* {111}, *r* {211}, *s* {311}, *v* $\{\bar{2}11\}$, and *e* $\{\bar{3}11\}$ Crystallographic elements: $a : b : c = 1{\cdot}7376 : 1 : 0{\cdot}4254$ $\beta = 92°58'$; $p_0 : q_0 : r_0 = 0{\cdot}2448 : 0{\cdot}4248 : 1$; $r_2 : p_2 : q_2 = 2{\cdot}3540 : 0{\cdot}5763 : 1$; $\mu = 87°02'$; p_0' 0·2451, q_0' 0·4254 x_0' 0·0519. K. S.

Sunagawa (Ichiro). *Growth history of hematite.* Amer Min., 1960, **45**, 566–575, 6 figs.

The history of growth from two-dimensional nucleatio to spiral growth and of the movement of dislocations afte growth was observed on a single crystal of hematite fro Saganoshima, Japan. The end growth history of th crystal is explained. [M.A. **14**–328] A. C. H.

Cahn (J. W.). *Theory of crystal growth and interfac motion in crystalline materials.* Acta Metallurgica 1960, **8**, 554–562, 3 figs.

The theory of crystal growth for diffuse and for non singular surfaces is re-examined. It is found that if critical driving force is exceeded the surface will be able t advance normal to itself without needing steps; if thi driving force is not exceeded lateral step motion is necessary For extremely diffuse interfaces this critical driving forc will be so small that any measurable driving force wil exceed it. For sharp interfaces the critical driving forc will be very large, and most growth will occur by latera step motion. For most systems, however, the critica driving force should be accessible experimentally. The nature of a step in a diffuse interface is discussed and it energy calculated. The conditions for interface motio by classical nucleation and screw dislocation mechanism are derived. R. G. Wls.

ECONOMIC MINERALS AND ORE DEPOSITS

General : ore genesis, structure

ARK (I. W.). *Exploitation of minerals for mankind (The fifth Sir Julius Wernher Memorial Lecture).* Trans. Inst. Mining & Metall., 1960, **69**, 444–458.

Some examples of mineral processing and exploitation by e C.S.I.R.O. Laboratories, Melbourne, are coupled with a ea for a greater spirit of adventure in research on the ocessing of minerals. R. A. H.

ILLIAMS (D.). *Genesis of sulphide ores.* Proc. Geol. Assoc., 1960, **71**, 245–84.

The hall-mark of specific metals is imprinted on metallo-netic provinces by deep-seated processes in early ological time, the pattern of ore districts being often lated to profound crustal lineaments along which ore uids rise from the depths. Many sulphide deposits are rived from hydrothermal solutions residual from granitic utons. Granitisation may lead to concentration of ore-rming metals into resistant country rocks or mobile anitic fluids, and to their incorporation into hospitable inerals. Metamorphism may produce ore deposits, pecially in open systems which facilitate migration, and es may be regenerated by hydrothermal fluids of mag-atic, metamorphic, or even ground-water nature. Among dimentary sulphide ores those of submarine-hydrothermal igin seem to be dominant. M. G. B.

ARMO (V.). *On the origin of ores.* Neues Jahrb. Min., Abhandl., 1960, **94**, 77–89.

The origins of ores are considered from the standpoint an ore prospector. It is concluded that sediments are e main source of the ore-forming materials and may also eld the potassium of late-kinematic granites which often company the ores. [M.A. **14**–474] R. A. H.

CHRÖCKE (H.). *Einige allgemeine Beziehungen der magmatogenen Lagerstättenbildung.* Neues Jahrb. Min., Abhandl., 1960, **94**, 90–97.

The maximum and minimum magmatic pressures during e formation of ore deposits are estimated and discussed terms of the segregation of emanations from the magma nd their ascent in relation to step-like pressure decreases. egmatitic deposits are explained in terms of the albite–ater and albite–water–sodium chloride systems. The egree of dissociation of magmatic solutions is estimated. R. A. H.

OLLAND (HEINRICH D.). *Some applications of thermochemical data to problems of ore deposits. I. Stability relations among the oxides, sulphates and carbonates of ore and gangue metals.* Econ. Geol., 1959, **54**, 184–233, 45 figs.

Stability fields of the sulphides, oxides, and sulphates of 19 common metals are expressed in diagrams in which temperature and the fugacities of S_2 and O_2 are the variables. Additional diagrams define, where the necessary thermochemical data is available, the fields of stability for the same metals, their sulphides, oxides, sulphates, and carbonates, expressed in terms of temperature and the fugacities of S_2, O_2, and CO_2. The relationships described are designed to illustrate the thermochemical characters of ore-forming fluids and correlate them with the mineralogical features of hydrothermal ore deposits. W. E. H.

CZAMANSKE (C. K.). *Sulphide solubility in aqueous solutions.* Econ. Geol., 1959, **54**, 57–63.

As a result of redeterminations of basic thermodynamic data, solubilities for nine of the common sulphides have been revised. Calculations have been made for temperatures of 25°, 100°, 200°, 400°, and 600°C, and for pH values of 3, 7, and 11. The solubility data permit the following generalizations : (1) the more acid solutions can universally carry more metal ion in solution at a given temperature than alkaline solutions ; (2) as the temperature rises the amount of metal ion in solution varies less with change in pH, especially in the alkaline region ; (3) with the exception of the anomalous behaviour of FeS and MnS, the concentration of the metal ions increases with temperature ; (4) the relative solubilities of PbS and ZnS change at about 300°C, ZnS being the more soluble compound at low temperatures and PbS the more soluble compound above 300°C ; (5) the solubilities of ZnS and CdS are similar and are virtually identical at 400°C ; (6) Cu_2S and CuS are about equally soluble. G. S. C.

MARMO (V.). *On the theory of exhalative-sedimentary ores.* Geol. Fören. Förh., Stockholm, 1958, **80**, 277–282.

Marmo does not fully share Oftedahl's opinions [M.A. **14**–181] on the dominance of gaseous exhalations in ore formation nor on the origin of the exhalations. Though porphyries associated with the ores are often acid they are not always of granitic composition and as regards the acid rocks themselves there is uncertainty often about their origin. If the gaseous exhalations are derived from palingenetic magmas the resulting ores should contain all the ore elements mixed as in the source rock and not differentiated into oxide and sulphide deposits. Many ores, particularly bonded ironstones, probably have obtained their iron from gaseous exhalations but there are other modes of precipitation of iron, for example ; in graphite-sulphide schists which are interpreted as derivatives of sapropelic sediments ; as accumulations of iron hydroxides

in lakes ; by lateritization which may cause considerable concentrations of iron ; and as heavy concentrates in placer deposits. E. W.

Kautsky (G.). *The theory of exhalative-sedimentary ores proposed by Chr. Oftedahl. A criticism.* Geol. Fören. Förh., Stockholm, 1958, **80**, 283–287.

Referring to Oftedahl's explanation of the Huelva [Spain] province as exhalative-sedimentary Kautsky calls attention to descriptions by G. Williams of the Perunna-LaZarza orebody [Bull. Inst. Mining & Metall., 1932, no. 336] and D. Williams of the Rio Tinto mines [Bull. Inst. Mining & Metall., 1934, no. 355] ; so far from being genetically related to ignimbritic tuffs the porphyry bodies associated with the Huelva ores alter the Palaeozoic, partly fossiliferous country rock in a wide contact aureole. In the Sulitelma area Kautsky has shown the absence of acid volcanics as close associates of the orebodies and also the earlier age of the abundant basic effusives. No field observations support a hypothesis of metasomatic transportation of sulphides from ores of sedimentary origin. The ores at Leksdal contrary to Oftedahl's reference to them as 'vasskis' are not of that type. [M.A. **14**–181] E. W.

Landergren (S.). *Comments to 'A theory of exhalative-sedimentary ores'.* Geol. Fören., Stockholm, 1958, **80**, 288–290.

Limiting discussion to the formation of iron oxide ores Landergren, from the geochemist's point of view, does not accept Oftedahl's explanation of them as the result of enrichment and transport of iron solely by agency of volatile activity emanating from a granitic magma chamber. Iron-rich exhalations are possible only if halogen compounds, but no water, are present. The degree of oxidation of Swedish skarn iron ores also makes the exhalative-sedimentary origin improbable. [M.A. **14**–181] E. W.

Oftedahl (C.). *On exhalative-sedimentary ores. Replies and discussion.* Geol. Fören. Förh., Stockholm, 1959, **81**, 139–144.

Oftedahl estimates the magma chambers (bodies of granite rocks) in the Oslo area to be at maximum $20 \times 20 \times 10$ km and refers to Goldschmidt's conclusion that ore deposits along the contacts of these plutonic bodies are the result of enrichment and transportation of iron, etc., solely by the aid of some kind of volatile activity from a granitic magma chamber. He admits that it at present is not easy to imagine how iron is enriched in the gas phase but supposes that superheated H_2O gas may be a potent solvent. The association of porphyries with ore bodies he explains by the interaction between Na-rich sea water and hot, acidic glass particles. He gives as further examples of exhalative-sedimentary ores the deposits at Meggen and Rammelsberg. Discussing the possibility of re-distribution of the ore-forming material he suggests that the deposits of Upper Silesia have been formed from truly sedimentary horizons by mobilization of sulphides into adjacent beds of dolomite. Finally he insists that transitions between Caledonian 'vasskis' type of pyrite deposits and 'gangkis' ores do occur. E. W.

Kullerud (G.), Vokes (F. M.), & Barnes (H. L.). *On exhalative-sedimentary ores.* Geol. Fören. Förh., Stockholm, 1959, **81**, 145–148.

Well-known data from the Valley of Ten Thousand Smokes [Alaska] and the Cyclades [Greece] show that while some or all of the mineral constituents of certain ore-bodies may occur in volcanic gases, the concentrations are many orders of magnitude lower than necessary for extensive ore deposition even from the largest imaginable volumes of volcanic exhalations. Chemical data also show that sufficient iron for an ore deposit cannot be transported in solution in sea water. E. W.

Gavelin (S.). *Malmgenes* [Ore genesis]. Geol. Fören. Förh. Stockholm, 1959, **81**, 297–303.

In a lecture at the 7th Northern Geological Congress the author discusses the genetic problems of some important ore-types in Sweden. He points out that the history of the formation of the ore deposits has to be inserted in a large petrogenetic development. The ore formation is polygenetic and with the aid of geochemical investigations, determinations of lead-, sulphur- and oxygen-isotopes attempts have been made to throw light upon ore concentrations prior to those which can be studied by means of field data. The forms and emplacement of the epigenetic sulphide ores are determined by folds and fractures formed in the tectonic development and very often in close connection with the palingenic phase. E. W.

Ovchinnikov (L. N.). *Some regular phenomena in the magmatogene ore genesis.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **16**, 7–16, 1 fig.

A magma can be considered as an ionic-electronic micro-heterogeneous liquid containing atoms of iron and other metals in solution : these metals separate by liquation caused by a change in the melt composition. The separated ore coalesces and in granitoids is transported by gas bubbles ; in basic melts poor in gases the ores precipitate in the rock. Experiments show that between limestone and basalt melt an intensive diffusion occurs, the relative mobility being $K > Na \gg Fe > Mg \gg Al > Si$ [$\gg$ much greater]. R. A. H.

ANUŠ (V.). *Hydrothermal metasomatism and its relationship to other ore-forming processes.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **16**, 67–78, 9 figs.

Consideration of the genesis of ores in soluble rocks sugests that the presence of solution cavities and their filling of great importance in metasomatic rocks. Such deposits ay be formed by the filling of solution cavities, of the rder of millimetres to metres, which are produced by the ineralization process itself; this process is designated olvate apposition. Hydrothermal metasomatism is conidered as a member of the continuous genetic series of ydrothermal mineralization processes—as a special case f solution accompanied by filling of open spaces. It is he product of simultaneous and equilibrium action of olution and deposition, these processes being capable of ndependent action under suitable conditions. R. A. H.

ARPENTER (R. H.). *A resumé of hydrothermal alteration and ore deposition at Questa, New Mexico, U.S.A.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **16**, 79–86, 2 figs.

The hydrothermal alteration and molybdenite mineralisaion of the Questa mine, Sangre de Cristo Mountains, are ssociated with granite-porphyry, porphyritic aplite, and hyolite-porphyry which have intruded Tertiary volcanic ocks and pre-Cambrian gneisses and schists. Veins with uartz and molybdenite also contain rhodochrosite, pyrite, luorite, and calcite. R. A. H.

AUTZSCH (E.). *Über Anzeichen von Buntmetallvererzung in permischen, vulkanischen und subvulkanischen Gesteinen Mitteldeutschlands.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **16**, 87–98, 1 fig.

The genesis of the hydrothermal nonferrous metal ores f the Permian volcanic rocks of central Germany is iscussed. R. A. H.

HOWDHURY (M. K. R.), SUBRAMANIAM (M. R.), & BANERJEE (P. K.). *Source bed concept in some sulphide ore bodies from the western Himalayas.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **16**, 138–148, 3 figs.

Sporadic occurrences of low temperature galena-sphaleite-chalcopyrite mineralization are found in Permo-arboniferous dolomite bodies over a stretch of 450 miles n the western Himalayas. The deposits are restricted to articular stratigraphical horizons and do not appear to be elated to igneous intrusions in the area. It is suggested hat the primary sediments in the area carried abnormal oncentrations of Pb, Zn, and Cu, which were remobilised nd redistributed in structurally weak zones. R. A. H.

MARMO (V.). *On the possible genetical relationship between sulphide schists and ores.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **16**, 160–163.

It is considered that in many of the so-called hydrothermal ores, emplaced under hydrothermal conditions, the ore-forming material has been derived from sediments, mainly from sulphide-graphite schists. R. A. H.

SMIRNOV (V. I.). *Types of hypogene zonality of hydrothermal ore bodies.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **16**, 181–191, 4 figs.

Zonality in the distribution of ore-forming mineral complexes in the outskirts of hydrothermal ore bodies may be due to successive elimination from the magma of ore-bearing solutions of different composition, or to a change in geological and physical-chemical conditions of the ore-bearing solutions along their routes. Three varieties are distinguished in each type of zoning and examples of each are briefly discussed. R. A. H.

KOCH (G. S., *Jr.*) & LINK (R. F.). *Zoning of metals in two veins of the Frisco mine, Chihuahua, Mexico.* Rept. 21st Intern. Congr., Norden, 1960, Part **16**, 192–199, 8 figs.

The Frisco mine, San Francisco del Oro, produces Au, Ag, Pb, Cu, and Zn from about 40 fissure veins, the zoning in two of which has been studied by the examination of 38,000 assays of mine samples. Detailed contour maps are drawn for the 5 metals and for their relative abundances, etc. R. A. H.

GILL (J. E.). *Solid diffusion of sulphides and ore formation.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **16**, 209–217, 8 figs.

Experimental heating of ore samples shows that diffusion occurs in copper sulphides at temperatures above 400°C; the rates of diffusion are considered to indicate a possible mechanism in processes of formation of ore deposits. Less striking diffusion occurs in FeS, PbS, ZnS, and possibly in other sulphides. [M.A. **8**–254] R. A. H.

CREASEY (S. C.). *Some phase relations in the hydrothermally altered rocks of porphyry copper deposits.* Econ. Geol., 1959, **54**, 351–373, 12 figs.

ACF (Al_2O_3, CaO, and FeO+MgO+MnO) and AKF (Al_2O_3, K_2O, and FeO+MgO+MnO) diagrams are used to distinguish three alteration facies — (1) a propylitic alteration, with muscovite, epidote, chlorite, and a carbonate; (2) a potassium silicate alteration with muscovite, biotite, and K-feldspar; and (3) an argillic alteration with kaolinite and muscovite. The first grades into the latter two which are associated with the ore deposits.

J. T. W.

Gill (J. E.), chairman. *Symposium on the genesis of massive sulphide deposits.* Trans. Canad. Inst. Mining & Metall., 1959, **62**, 318–357.

Five papers presented at the annual general meeting in Montreal, April, 1959, include :

Gunning (H. C.). *Origin of massive sulphide deposits.* Op. cit., **62**, 318–321,

and the four papers abstracted below ; the ensuing discussion is reported in pp. 354–357. G. P.

Sullivan (C. J.). *The origin of massive sulphide ores.* Trans. Canad. Inst. Mining & Metall., 1959, **62**, 321–327, 3 figs., 1 table.

In a brief review of massive sulphide deposits of world distribution two general ideas are sustained. (1) Particular sedimentary environments produce particular types of metalliferous provinces, as also do various types of basic intrusives. Examples are : Pb–Zn ores in limestone—granite bodies often associated, and tungsten common ; massive pyritic Zn–Pb–Cu ores, concentrated in structural foci ; ores in algal or coralline reefs, some Pb, Pb–Zn, and Cu–Co–U deposits ; Cu and Cu–U deposits in red-beds ; Zn–Cu ores associated with basic intrusives, Mg–Fe metasomatism frequent ; Ni and Ni–Cu ores associated with ultrabasic igneous rocks ; and no sulphide orebodies occur in aeolian sediments. (2) The formation of massive sulphide ores results principally from the application of heat to bodies of rock with dispersed metal content ; separation of sulphide and silicate phases depends on relative thermal stabilities, not on solubility in water. Thermal stability ranges are reflected in spatial arrangements of sulphides round intrusive porphyries and in hydrothermal alterations around orebodies. Shield areas have a high ratio of iron sulphide to sulphides stable at low temperature ; cordilleran areas have a low ratio. G. P.

Wilson (H. D. B.) & Anderson (P. T.). *The composition of Canadian sulphide ore deposits.* Trans. Canad. Inst. Mining & Metall., 1959, **62**, 327–339, 7 figs., 7 tables.

Canadian sulphide orebodies can be broadly classed as Cu–Ni–Co ores, Cu ores, Cu–Zn ores, Zn–Cu–Pb ores. For the Cu–Ni–Co ores statistical data are given on the ratios pentlandite : pyrrhotine, Cu : (Cu+Ni), Co : Ni, and Co : Cu. Ni is highest (10%) in ores associated with peridotite, falling to 5·0%, 2·6 to 6%, 0·5% respectively in ore associated with pyroxenite, norite, anorthosite ; the ratios Ni : Cu and Ni : Co show similar variation in peridotite, pyroxenite, norite, and diabase and gabbro. The partition ratios for Cu and Ni into the sulphides separating from silicate rock or magma is believed to vary with the stage of crystallization. The vertical distribution of Cu : (Cu+Ni) varies for different orebodies ; at Falconbridge mine it is constant, whereas at Frood mine it increases with depth. These data are believed to support the views that Falconbridge orebody is an injected sulphide melt and Frood orebody is a magmatic segregation in place. For Cu–Zn–Pb ores : there are characteristic metal ratios for certain ore bodies within districts ; Cu and Zn are concentrated in gabbro and diorite ; the Cu–Zn ores of northwestern Quebec are spatially related to gabbros and diorites. Base metal ratios in common sedimentary rocks are not similar to the ratios in orebodies ; base metal ratios may be modified by high-grade metamorphism. The distribution of elements in sulphide orebodies suggests that Cu, Zn, and Pb are deposited simultaneously in relatively constant proportions rather than successively in a paragenetic sequence. Zoning may be due to different ratios of metals being deposited under changing temperature, pressure and chemical environment, or may be the result of other processes. G. P.

Stanton (R. L.). *Mineralogical features and possible mode of emplacement of the Brunswick Mining and Smelting [Corporation] orebodies, Gloucester County, New Brunswick.* Trans. Canad. Inst. Mining & Metall., 1959, **62**, 339–351, 2 figs.

The ores are banded pyritic type, major constituents other than pyrite being magnetite, pyrrhotine, blende, galena, and chalcopyrite ; minor associated constituents are tetrahedrite-tennantite, arsenopyrite, enargite, and others. The ore-bearing rocks are low-grade metamorphic quartz-carbonate-chlorite-sericite assemblages containing variable quantities of magnetite, sulphides, and carbon. The writer suggests that these ores may be metamorphosed sulphide rocks, the original minerals and their textures having developed during compaction and folding of the containing sediments. Submarine and seaboard volcanic fumaroles, manifestations of the known vulcanism of the area, and springs may have contributed large quantities of metallic halides, sulphates, and other sulphur compounds to a sedimentary facies particularly conducive to reduction. In zones of fairly quiet and undisturbed sedimentation, the sulphides may have built up as cryptocrystalline mixed precipitates. Biological activity may have been important in the precipitation process. G. P.

Watson (K. D.). *Origin of banded structure in some massive sulphide deposits.* Trans. Canad. Inst. Mining & Metall., 1959, **62**, 351–354, 6 figs.

The banded sulphide deposits of the Mindamar mine, Stirling, southeastern Cape Breton Island are examined. The host rock is a laminated siltstone of the Bourinot group (Middle Cambrian) transformed by low grade metamorphism into a siliceous sericite schist. In many places

ydrothermal dolomite and magnesite with colloform extures have developed. The metallic minerals in order f decreasing abundance are pyrite, blende, chalcopyrite, alena, and tennantite. The banded structure in which ayers rich in sulphides alternate with those rich in gangue inerals has probably originated by replacement of relic amination in the schist. Sulphide replacement seems to ave started in the coarser, quartz-rich portions of laminae. halcopyrite was among the last of the ore-minerals to be eposited ; where chalcopyrite-rich alternate with pyrite- nd blende-rich layers, it is presumed that chalcopyrite ay have replaced the highly-schistose sericite-rich layers ore readily than it did the sulphide-rich layers. Late ovements in the controlling shear structures are also dicated and the banding of blende-rich and pyrite-rich ayers may also be explained as an effect of this control. ther hypotheses for the origin of these ores are considered.

G. P.

TANTON (R. L.). *Abundances of copper, zinc, and lead in some sulfide deposits.* Journ. Geol., 1958, **66**, 484–502.

A report on the results of several thousand analyses for opper, zinc, and lead made on specimens from 14 sample ulfide deposits from Australia, Canada, and Eire. The 14 eposits chosen are all of the conformable type and they re mineralogically and structurally similar. The deposits tudied have chemical similarities in persistently exhibiting w copper content, poor correlation between copper and inc, good correlation between lead and zinc, similarity of ead : zinc ratios, and marked consistency in the behaviour f the ternary group copper-zinc-lead. H. L.

AITO (TADAO). *On minor elements in ore minerals of the Yakumo mine, Hokkaido, Japan.* Journ. Fac. Sci. Hokkaido Univ., 1953, ser. iv, **8**, 267–276, 2 figs., 3 tables.

The distribution of minor elements in quartz, rhodochrosite, galena, blende, pyrite, and chalcopyrite from the everal stages of mineralization in a Pb–Zn–Mn deposit has een determined spectrographically. A few observations re also reported on calcite, baryte, tetrahedrite, and labandite of the last stage of mineralization only. The inor elements fall into 4 groups showing concentration 1) continuously increasing, (2) continuously decreasing, 3) increasing and then decreasing, and (4) decreasing and nen increasing during the successive stages of mineraliza- ion. In at least one of the principal minerals studied the lements falling in these groups are : (1) Pb, Sb, Mg, Zn ; 2) Al, Cu, Au, Ag ; (3) Si, Fe, Mn, Ti, Ca ; (4) Cd, Be, Se, Sr, Ce, Ge, Ru, Rh, As.

A. P.

[DUDYKINA (A. S.)] Дудыкина (А. С.). Парагенетические ассоциации элементов-примесей в касситеритах различных генетических типов оловорудных месторождений [*Paragenetic associations of trace elements in cassiterites of various genetic types of tin deposits*]. Труды института геологии рудных месторождений, петрографии, минералогии и геохимии [Trans. Inst. Geol. Ore-deposits, Petr. Min. & Geochem.], 1959, **28**, 111–121.

The study of trace elements in 271 cassiterites of different genesis has shown that every genetic type is accompanied by a deposit assemblage of trace elements. The cassiterites of sulphides-cassiterite formation, for example, are accompanied by W, Pb, Sb, Ag, In, As, and Ga. Cassiterites from pegmatites are accompanied by Zr, Nb, and Ta. S. I. T.

MITRA (S.). *Trace elements in the chromite ores occurring around Saruabil (Cuttack district) Orissa.* Sci. & Culture, 1960, **25**, 698–699.

Reports traces of platinum, nickel and manganese in the chromite, based on quantitative tests and confirmed by spectrograms. A. P. S.

SAEBØ (PER CHR.), SVERDRUP (THOR L.), & BJØRLYKKE (HARALD). *Note on 'birds-eye' textures in some Norwegian pyrrhotite-bearing ores.* Norges Geol. Unders., 1960, **211**, 205–211, 3 figs.

'Birds-eye' textures in pyrrhotine (Schneiderhöhn & Ramdohr, 1931, Lehrb. d. Erzmikroskopie, vol. 2) are observed in polished sections of 3 Norwegian ores. They are interpreted as due to late (post-glacial) incipient oxidation and alteration near the surface. The difference between these textures and very similar colloform textures is pointed out. I. W. O.

Ore deposits : general, specific

REYNA (J. GONZÁLEZ). *Memoria Geologico – Minera del Estado de Chihuahua (minerales metálicos).* 20th Congr. Geol. Intern., México, 1956, 280 pp., 1 fig., 1 folding map (in pocket), 3 tables.

A list of mines in the State of Chihuahua, Mexico, giving brief details of the mining history and production of each mine. A catalogue of about a hundred minerals indicates the mines at which each occurs. R. A. H.

REYNA (J. GONZÁLEZ). *Riqueza minera y yacimientos minerales de México : Tercera edicion.* 20th Congr. Geol. Intern., México, 1956, 497 pp., 14 maps & 1 geol. map (in pocket).

The mines and mineral deposits of Mexico are described in considerable detail. The production and occurrences of the various metals are recorded, with particular emphasis

on Au, Ag, Pb, Zn, Cu, Hg, Sb, Mn, Fe, Sn, U, and graphite. The future development in Mexico is discussed. R. A. H.

Maucher (A.). *Die Kieserze von Keltaş, ein Beispiel submariner Gleitfalten in exhalativ-sedimentären Erzlagerstätten.* Neues Jahrb. Min., Abhandl., 1960, **94**, 495–505, 6 pls.

The ore deposits associated with the Cretaceous-Tertiary igneous activity in the ore-province of the eastern Pontides, Turkey, are in the form of subvolcanic dykes, impregnations, and breccias, and also submarine sediments, precipitated from volcanic exhalations or solutions genetically related to dacitic lavas. The ore minerals include pyrite, chalcopyrite, blende, galena, bornite, enargite, and boulangerite. R. A. H.

Boyle (R. W.). *The geology and geochemistry of the silver-lead-zinc deposits of Galena Hill, Yukon Territory.* Geol. Survey Canada, 1957, Paper **57**–1, 41 pp.

The rocks underlying Galena Hill consist of sericitic, chloritic, and graphitic schists, thick- and thin-bedded quartzites, greenstones, and a few lenses of limestone. The vein fault systems are described in some detail. In general, the ore-bearing veins consist of brecciated and sheeted zones in thick-bedded quartzites and greenstones, and narrow fractures in schists and thin-bedded quartzites. The complex sequence of mineralization includes both hypogene and supergene processes. Small quartz lenses containing some pyrite and carbonate were the first to form, probably by local secretion. This process was followed by development of early faults and deposition of quartz veins carrying a little pyrite. Later movement along vein faults was followed by deposition of chalybite, galena, blende, pyrite, freibergite, and chalcopyrite. The lodes are highly oxidized near the surface and down to a maximum depth of 600 feet in some veins resulting in the formation of iron and manganese oxides, anglesite, hawleyite, cerussite, calcite, azurite, quartz, malachite, plumbojarosite, silver-bearing jarosites, and native silver. Precipitation of supergene calcite, quartz, blende, native silver, pyrargyrite, and galena has taken place in the zone of reduction below the temporary water table. R. J. T.

Steven (Thomas A.) & Ratté (James C.). *Geology and ore deposits of the Summitville district, San Juan Mountains, Colorado.* Prof. Paper U.S. Geol. Survey, 1960, **343**, 70 pp.

The district has produced gold, silver, copper, and lead. New chemical analyses are given for two rhyodacites, three quartz latites, and one vitrophyre. Chemical analysis, by Lucile N. Tarrant, of an impure specimen of alunite with $Na_2O : K_2O = 28 : 72$ gave SiO_2 39·00, Al_2O_3 23·21, Fe_2O_3 0·16, MgO nil, CaO nil, Na_2O 1·19, K_2O 4·53, H_2O- nil, H_2O+ 7·92, TiO_2 0·05, SO_3 23·36, BaO 0·07, = 99·49; ω 1·578±0·002, ε 1·597±0·002. K. S.

Overweel (C. J.). *The central alteration body of the Casapalca mines, Peru.* Geol. en Mijnbouw, 1961, new ser. **23**, 1–10, 13 figs., 1 table.

The Casapalca mining district in central Peru is a source of lead, zinc, silver, and copper ores of the leptothermal type. In the centre of the mine in the shingle zone of the most conspicuous parallel vein-system, a body of rock has been intersected that does not fit in the stratigraphical sequence. Various opinions about its origin have been brought forward. The results of a systematic thin-section study of the rock in question are in favour of alteration. The coincidence of ore shoots and alteration body with certain structural elements of the Casapalca anticlinorium is discussed. P. C. Z.

Alderman (A. R.). *The mineral regions of South Australia.* Indian Min., 1960, **1**, 1–10, 1 fig.

A brief survey of South Australian mineral deposits. A. P. S.

Imai (Hideki). *The vein system of the Hosokura and Ôdomori mines, northern Japan* (Geological studies of the copper, zinc and lead deposits in Japan and her neighbours : (5)). Japanese Journ. Geol. Geogr., 1956, **27**, 21–35, 18 figs.

The ore minerals of these lead and zinc mines include 'wurtzite' converted to blende [M.A. **11**–64]. The system of fissures filled with vein materials is described and the mechanism of its formation discussed. A. P.

Suzuki (Jun). *Ultra-basic rocks and associated ore deposits of Hokkaido, Japan.* Journ. Fac. Sci. Hokkaido Univ., 1952, ser. iv, **8**, 175–210, 1 fig., 9 tables.

The geological setting of the ultrabasic rocks, their associated dike rocks, and the related contact-metamorphic rocks are described. Forty-two analyses, mostly taken from the literature, are tabulated for each group. Several types of glaucophane schist are listed as 'special contact rocks'. Ore deposits associated with serpentinite include those of chromite, placer chromite, placer iridosmine and native gold, chrysotile asbestos, mercury, nickel, copper, and talc. Analyses are tabulated for chromites and chromite ores (8), platinum group metals (10), and chrysotile asbestos (5). This is a general summary of work on these rocks and the ore deposits of Hokkaido with a bibliography of 97 items (77 in Japanese) for 39 of which J. Suzuki is listed as author or coauthor. [M.A. **14**–403] A. P.

ORSTER (I. F.). *Beobachtungen an einem primären Goldvorkommen in ultrabasischen Gesteinen des Lowvelds (Nordost Transvaal, S.A.).* Neues Jahrb. Min., Abhandl., 1960, **94**, 228–266, 2 figs., 4 pls.

A lens-like ultrabasic igneous complex in the early precambrian granite-gneiss of the Low Veld, northeastern ransvaal, shows layering due to magmatic differentiation. n association of olivine and gold occurs in the footwall f the complex ; because of cataclasis in situ and metaorphism, gold has recrystallized and locally concentrated. he original magma was also rich in pyrrhotine, magnetite, nd calcite : other minerals present include chalcopyrite, entlandite, linnaeite, valleriite, heazlewoodite, millerite, waruite, rickardite, graphite, and eskolaite [M.A. **14**–199]. nusual intergrowths, replacements, and structures of hromites are described. R. A. H.

RASIMA (YUKITOSI). *Mineralization of central Kitami mining district in Hokkaido, Japan.* Journ. Fac. Sci. Hokkaido Univ., 1957, ser. iv, **9**, 597–606, 1 geol. sketch map, 4 tables.

Base metal, gold-silver, and mercury ores are found in is district on the north shore of Hokkaido. The ore and angue minerals of eleven deposits, including three or more xamples of each type, are listed in a comprehensive table. ll of the deposits are associated with Tertiary volcanic ocks. A. P.

RASIMA (YUKITOSI). *'Bosa' quartz veins, especially the fine-grained quartz aggregates of the Konomai mine in Hokkaido, Japan.* Journ. Fac. Sci. Hokkaido Univ., 1956, ser. iv, **9**, 371–380, 3 figs., 2 pls.

'Bosa' quartz veins is a term used locally for veins mposed of sandy, saccharoidal, lamellar, tabular, and ther aggregates. In this study of such veins at the onomai mine, the largest gold-silver mine of Japan, the enesis of the ore deposits and the distribution of assay alues are discussed. A. P.

AYLAND (R. G.). *The Alaska Juneau gold ore body.* Neues Jahrb. Min., Abhandl., 1960, **94**, 267–279, 3 figs.

The gold occurs principally in quartz veins in slate, ssociated with metagabbroic or greenstone bodies. The ost abundant sulphide mineral is pyrrhotine, and other lphides include pyrite, arsenopyrite, chalcopyrite, and trahedrite. Zoning in the sulphides ranges from mainly yrrhotine to an increasing proportion of blende, galena, nd arsenopyrite, with a corresponding decrease in the tio of gold to silver. R. A. H.

HALEN (EINAR). *Ravings about gold in Sweden.* Rocks and Minerals, 1956, **31**, 284.

Brief comments on various gold mines and prospects in Sweden. An auriferous vein has recently been discovered in a granite quarry in Stammeberget, Tossene, province of Bohuslän. R. S. M.

FRIEDRICH (G.). *Petrographische und erzmikroskopische Beobachtungen an der Goldlagerstätte Rodalquilar, Prov. Almeria/Spanien.* Neues Jahrb. Min., Abhandl., 1960, **94**, 208–227, 9 figs., 4 pls.

A description is given of the mineralization affecting altered igneous rocks in a series of crystalline schists. There are five known ore zones : the mineralization involved silicification and pyritization followed by alunitization and a second silicification. The ore minerals include pyrite, marcasite, pyrrhotine, covelline, and delafossite. During alunitization jarosite, goethite, lepidocrocite, and native gold were formed. Spectrochemical tests showed primary gold in pyrite. R. A. H.

BOYLE (R. W.). *Occurrence and geochemistry of native silver in the lead-zinc-silver lodes of the Keno Hill–Galena Hill area, Yukon, Canada.* Neues Jahrb. Min., Abhandl., 1960, **94**, 280–297, 3 figs.

The native silver is of secondary origin, derived by the oxidation of freibergite and argentiferous galena, the principal Ag-bearing minerals in the deposits : such deeply oxidized lodes are uncommon in Canada. Unusual also are the lenses of ice in the permafrost zone, extending to depths of 75 to 200 feet. Splendent leaf silver occurs mainly in clear ice lenses in the oxidized zones. Other minerals in the oxidized parts of the lodes include anglesite, bindheimite, scorodite, melanterite, acanthite, and Ag-bearing beudantite and plumbojarosite. R. A. H.

EDWARDS (A. B.). *Contrasting textures in the silver-lead-zinc ores of the Magnet mine, Tasmania.* Neues Jahrb. Min., Abhandl., 1960, **94**, 298–318, 4 figs., 9 pls.

The Ag-Pb-Zn ore of the Magnet mine, 4 miles west of Waratah, Tasmania, shows two strongly contrasted groups of textures giving a true and a pseudo-paragenesis. One group is due to a repeating crustification, appearing as rhythmic banding and as cockade textures, during early and late stages of deposition. The other group is due to shearing and partial recrystallization of the ore at an intermediate stage. The sulphide minerals and the associated manganosiderite were deposited at or above 400°C ; Mn constitutes about 10% of the orebody. The minerals of the ore include blende, galena, arsenopyrite, pyrite, boulangerite, and pyrargyrite. Analyses are given of blende, manganosiderite, and ferroan dolomite. R. A. H.

JURKOVIĆ (I.). *Quecksilberfahlerz vom Mačkaragang bei Gornji Vakuf in Bosnien (Jugoslavien).* Neues Jahrb. Min., Abhandl., 1960, **94**, 539–558, 6 figs.

A baryte-chalybite vein with some quartz and calcite, at Mačkara, Bosnia, also has small amounts of tetrahedrite containing 7·51% Hg, with a 10·18Å. Analysis of this tetrahedrite, by I. Jurković, gave (mean of two) Ag 0·13, Hg 7·51, Cu 38·15, Bi 0·33, As 4·76, Sb 20·56, Fe 3·89, Zn tr., Al tr., CaO tr., MgO tr., SiO_2 0·05, H_2O- 0·02, S 24·92, =100·32. The reflectivity of the tetrahedrite has been particularly investigated. Other minerals present in small amounts are chalcopyrite, gold, sternbergite, argyropyrite, Au-telluride, and dolomite. R. A. H.

Harada (Zyunpéi) & Hattori (Tomio). *Über den Zinnober der Itomuka Mine, Hokkaidô, Japan.* Journ. Fac. Sci. Hokkaido Univ., 1955, ser. iv, **9**, 1–6, 7 figs., 2 tables.

The occurrence of cinnabar at the Itomuka mine, the most important mercury deposit of Japan, is described. Five small crystals (0·5–0·8 mm) were measured. Two morphological types are distinguished, (I) rhombohedral, (II) represented by but a single example, barrel shaped. Eight new forms are included among the 26 recorded. A table of two-circle angles is given. A. P.

Jaskólski (S.). *Beitrag zur Kenntnis über die Herkunft der Zinnlagerstätten von Gierczyn (Giehren) im Iser-Gebirge, Niederschlesien.* Neues Jahrb. Min., Abhandl., 1960, **94**, 181–190, 3 figs.

The geology and paragenesis of a cassiterite deposit in the Iser Mountains, Silesia, are described. It is suggested that this was originally a sedimentary concentration of cassiterite and magnetite in pelitic and arkosic rocks, which later, after both contact and regional metamorphism, recrystallized as schists and gneisses with macroscopic sulphides and microscopic cassiterite. Chemical analysis of a green chlorite (thuringite) from chlorite-biotite schist from Gierczyn gave SiO_2 37·56, TiO_2 tr., Al_2O_3 18·81, Fe_2O_3 tr., FeO 30·32, MnO 0·18, CaO 0·24, MgO 4·26, K_2O nil, Na_2O nil, ign. loss 9·04, H_2O- 0·03, =100·44; β 1·660.
R. A. H.

Štemprok (M.). *On the genesis of the ore deposit of Cínovec (Zinnwald).* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **16**, 43–53, 4 figs.

The Sn-W mineralization in the Cínovec district is associated with a system of flat veins developed inside a granite dome and proceeding for a short distance into the neighbouring quartz porphyry. The ore-forming process was preceded by albitization of the granite, flat fissures were formed and filled with quartz, and subsequently greisens were formed and extensive intravenous metasomatism took place during which the quartz veins were replaced by zinnwaldite, topaz, cassiterite, and wolframite. Later a potassium feldspar metasomatism occurred, and finally sulphides were deposited. R. A. H.

Radkewitsch (E. A.) & Poljakowa (O. P.). *Umwandlung von Sulfostannaten innerhalb von Zinnstein-Sulfid-Lagerstätten.* Neues Jahrb. Min., Abhandl., 1960, **94**, 191–207, 9 pls.

Complex Pb-Sn sulphide mineralizations of Bolivian type are described from Sinancha, Sikhote-Alin, and from Smirnovsk, Transbaikalia, both in the U.S.S.R. In Sinancha the ores occur in quartz porphyries, and in Smirnovsk they are in carbonate rocks. Both deposits contain cassiterite, galena, stannite, franckeïte, and teallite, with cylindrite only at Smirnovsk. The origin of such ores is discussed; their formation appears to be restricted to a narrow range of temperature, pressure, and concentration. Analysis, by J. S. Nestorova, of franckeïte from Smirnovsk gave Pb 49·25, Fe 3·42, Sn 15·88, Sb 10·62, S 20·90, =100·07. R. A. H.

Antun (P.). *Sur la genèse et les propriétés de stannines et de varlamoffites du Maniéma (Congo Belge).* Serv. géol. Congo Belge et Ruanda-Urundi, 1960, Bull. **9**, fasc. 2, 31 pp., 3 figs., 2 pls.

The sulphide minerals in the cassiterite deposit of Maniéma are associated with pneumatolytic quartz veins and include molybdenite, arsenopyrite, pyrite, chalcopyrite, blende, stannite, and galena. The stannite contains inclusions of cassiterite and chalcopyrite in constant proportions due to partial oxidation of the stannite at high temperatures. Varlamoffite associated with the stannite results from the attack of meteoric waters; its properties are not those of a mechanical mixture of tin and ferric iron hydroxides but are those of a distinct mineral. The d.t.a. curves of varlamoffites show a strong endothermic peak at around 130° and a weak exothermic peak at around 480°C; a thermogravimetric curve is also given. [M.M. **29**–817; M.A. **10**–8, 354, **11**–416] R. A. H.

Stumpfl (E.). *Über einige Beobachtungen an den Zinnlagerstätten von Rooiberg, Transvaal.* Neues Jahrb. Min., Abhandl., 1960, **94**, 162–180, 2 figs., 4 pls.

The intrusion of the Bushveld granite produced a fault system, which provided the channels for the entry of the ore-forming solutions into the host quartzites. Orthoclase, cassiterite, pyrrhotine, linnaeite, chalcopyrite, galena, valleriite, molybdenite, and bismuthinite are found, indicating a high temperature hydrothermal paragenesis. The widespread replacement of quartz and the partly contemporaneous formation of tourmaline and cassiterite indicate an alkaline character for the ore-forming fluids.
R. A. H.

E KUN (N.). *Les gisements de cassitérite et de columbo-tantalite du Nord Lugulu, Kivu, Congo Belge.* Ann. (Mém.) Soc. géol. Belgique, 1958–1959, **82**, M81–196, 43 figs., 3 pls.

Descriptions of the primary and secondary seams actually nown. The different zones of niobium and tin follow on ach other from the roof towards the aureole. In the most nportant deposits the ratio Sn : Nb reaches 15 : 1. Seven netalliferous formations (granite, pegmatite homogeneous nd zoned, veins, dykes, greisen, and quartz-mica rock) orm concentric zones. In pegmatites and dykes cassiterite in prismatic or pyramidal crystals of various tints ; the egmatites contain columbite also. Dykes and greisen con-ain cassiterite only. The columbite has an average content f 28% Ta_2O_5 ; radioactivity of columbites, measured at erkeley, varies from UO_3 0·03 to 0·41%. The age of the ocks is Precambrian. The main associated minerals are odumene, xenotime, tourmaline, ilmenite ; others cited rom placer concentrations are amblygonite, apatite, beryl, ismuth, bismutite, bismuthinite, brookite, chrysoberyl, orundum, traces of diamond. [M.A. **14**–107] J. M.

SHIBASHI (MASAO). *A Sn-Te-Bi-Sb paragenesis in ores from the Suttsu mine, Hokkaidô (Study of the minor minerals of ore. Rept.* 3). Journ. Fac. Sci. Hokkaido Univ., 1952, ser. iv, **8**, 97–106, 4 figs., 1 pl.

The occurrence of stannite, famatinite, bismuthinite, and zonite in composite veins exploited for lead, zinc, and on-sulphide is described. A. P.

AWRENCE (L. J.). *Cassiterite mineralization at Hall's Grampians, Emmaville, New South Wales.* Neues Jahrb. Min., Abhandl., 1960, **94**, 150–161, 2 figs., 3 pls.

Cassiterite occurs in association with ferriferous tremo-te, adularia, chlorite, and manganocalcite within a shear one in a contact-metamorphosed calcareous breccia. The ntimate association of cassiterite with manganocalcite and dularia is taken to indicate a low temperature hydro-hermal precipitation within the shear. Amphibole samples rom the metamorphosed breccia contain 0·10 to 0·30% Sn, nd chalcopyrite and arsenopyrite in an associated meta-omatic deposit have 0·055 and 0·030% Sn respectively hile blende has 9·36% FeS : these values all indicate a emperature of metamorphism of around 350°–400°C. The emperature of formation of cassiterite in the shear zone is ssessed at 300°C or lower. R. A. H.

ITTLE (H. W.). *Tungsten deposits of Canada.* Geol. Surv. Canada, 1959, Econ. Geol. Ser., no. 17, 250 pp.

This report includes all significant published data con-rning tungsten-bearing deposits in Canada up to the end f 1953 and much additional information. The properties of tungsten-bearing minerals and the general character and origin of tungsten deposits are summarized, followed by detailed descriptions of Canadian deposits and brief notes on some of the more important deposits of tungsten in other countries. The publication is well indexed and contains an extensive bibliography mainly on Canadian occurrences. R. J. T.

BJØRLYKKE (HARALD). *Supergene anrikninger av kopper i våre kisforekomster.* Norges Geol. Unders., 1960, **211**, 5–7, (English summary).

It is generally found that Norwegian copper-bearing pyrite deposits show a considerably higher content of Cu near the surface than in deeper parts. In a few cases a zone of leaching is found on top of the ore body. In the majority of cases it is assumed that such a zone existed prior to the period of denudation during the ice age, and that the Cu enrichment now near the surface was due to leaching of Cu from this zone and redeposition at lower levels. I. W. O.

IMAI (H.). *Geology of the Okuki mine and other related cupriferous pyrite deposits in southwestern Japan.* Neues Jahrb. Min., Abhandl., 1960, **94**, 352–389, 9 figs., 3 pls.

The Okuki mine is situated in schistose green rocks with intrusive basic rocks occurring in the cores of folds. The ore deposits were formed by hydrothermal metasomatism related to the basic intrusives and associated folding and dynamometamorphism, and consist of cupriferous pyrite. The ore is in most cases accompanied by ferruginous chert which is locally manganese-rich, with veins of rhodochrosite or rhodonite ; the presence of manganiferous hematite is suggested. R. A. H.

BÄCHTIGER (K.). *Ein neues intramagmatisches Kupfervorkommen in den Keratophyrlaven des Gandstockes (Kt. [Canton] Glarus, Schweiz).* Schweiz. Min. Petr. Mitt., 1960, **40**, 279–288, 4 figs.

A small find of copper sulfides is described. M. W.

BÄCHTIGER (K.). *Die Kupfermineralisation an der Mürtschenalp (Kt. Glarus, Schweiz).* Neues. Jahrb. Min., Abhandl., 1960, **94**, 627–635, 4 figs.

The copper ores of the Mürtschenalp, Switzerland, occur in chloritic lenses of a Permian siliceous conglomerate, either as diffuse grains or in veins with quartz, dolomite, and calcite. Pyrite, chalcopyrite, tetrahedrite, bornite, and molybdenite occur in the ore, with stromeyerite, native silver, and covelline in the cement ; secondary minerals include lepidocrocite, goethite, and malachite. A biogenic influence is suggested in the precipitation of the ores. R. A. H.

Lingen (G. J. van der). *The arsene-bearing copper ores of Canfranc Estacion (central Spanish Pyrenees).* Geol. en Mijnbouw, 1960, new ser. **22**, 729–736, 2 figs., 2 pls., 2 tables.

These ore deposits are found in the Lower Devonian shales and sandy limestones. The main part of the ore consists of arsenopyrite and pyrite. Other ore minerals are tennantite, bismuth, chalcopyrite, kobellite, and enargite. The most striking feature of the ores is their strongly cataclastic habit, probably due to tectonic movements during and after mineralization. A comparison between this mineral deposit and two others in this part of the Pyrenees is given. P. C. Z.

Ford (Ronald E.). *Geology of Gaspé Copper Mine.* Trans. Canad. Inst. Mining & Metall., 1959, **62**, 217–222, 6 figs., 1 table.

A summary description of the Gaspé Copper Mine, Prov. of Quebec. The host rocks are Lower Devonian calcareous shales, argillaceous limestones, and siliceous limestones. The orebodies are clustered around Needle Mt. and Copper Mt. At the former chert, diopside, and wollastonite were formed in the host rock before sulfide mineralization. The ore minerals are disseminated replacements ; they comprise chalcopyrite, pyrrhotine, with minor galena, blende, molybdenite, and scheelite. Needle Creek fault may have acted as an important channelway for the mineralizing solutions. At Copper Mt. diopside, garnet, and wollastonite were formed in a more massive and homogeneous host rock. Mineralization is more in the nature of fracture filling by quartz, chalcopyrite and pyrite, and is believed to be later than at Needle Mt. Some supergene enrichment has occurred. G. P.

Pollock (D. W.). *Sulfide paragenesis in the Eastern Metals deposit, Montmagny County, Quebec.* Econ. Geol., 1959, **54**, 234–247, 5 figs., 2 tables.

Two sub-parallel bodies of mineralization are localized within zones of silicification and carbonatization along the contact between a serpentinized peridotite and slate fingers penetrating into the southwest end of the peridotite. The nickel minerals millerite, gersdorffite, and violarite are characteristic of the north zone, chalcopyrite of the south zone. The different mineralogy of the two zones is interpreted as the result of the re-solution of separate pods of copper and nickel sulphides accumulated by early crystallization or by crystallization from an immiscible sulphide liquid fraction of the peridotite magma, the original separation into pods being due to difference in specific gravity of the sulphides. Solutions accompanying younger granodiorite dykes leached the pods of sulphides and redeposited the material as chalcopyrite, millerite, and gersdorffite in the reducing environment of the silica-carbonate contact zone and also derived blende from the country rocks. After the main period of mineralization violarite, bornite, and chalcocite were developed, possibly as a result of supergene processes. D. E. L.

Amstutz (G. C.). *The copper deposits Caprichosa and Antachajra in central Peru.* Neues Jahrb. Min. Abhandl., 1960, **94**, 390–429, 15 figs., 3 pls.

Two small copper deposits are described from Tertiary lavas in central Peru : analyses are given of 4 porphyries and of a rhyodacite tuff. The major ore minerals are limonite, malachite, azurite, bornite, and chalcopyrite. It is considered that these ore deposits are the result of syngenetic-hydrothermal or deuteric crystallization of cogenetically accumulated 'ore solutions'. R. A. H.

Carter (W. D.). *Origin of 'manto-type' copper deposits of the Cabildo mining district, central Chile.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **16**, 17–28, 5 figs.

The three types of bedded copper deposits in the coastal cordillera of Aconcagua Province, Chile, are chalcopyrite-pyrite ores which have replaced marine limestones, bornite in vesicles in a porphyritic andesite, and a chalcopyrite-bornite-chalcocite assemblage which has replaced the calcareous matrix of a conglomerate. The first type is a pyrometasomatic deposit ; contact metamorphism is indicated by abundant grossular. The other types appear to be mesothermal deposits of hypogene origin. R. A. H.

Michel (H.) & Scolari (G.). *Le gisement de cuivre-plomb-zinc de M'Passa, Vallée du Niari, République du Congo.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **16**, 112–125, 6 figs.

At M'Passa, west of Brazzaville, blende, galena, pyrite and chalcocite occur in calcareous strata and a copper mineralization (sulphides and oxides) is mainly localized in small joints and fractures in dolomite. The metals are considered to have had a primary syngenetic origin and to have subsequently been mobilized and locally concentrated. R. A. H.

Oelsner (O.). *Möglichkeiten zur Mobilisation von Blei-Zinkerzen aus bestehenden Lagerstätten und Kriterien zu ihrer genetischen Einstufung.* Neues Jahrb. Min. Abhandl., 1960, **94**, 98–120, 2 figs., 5 pls.

The criteria for mobilized primary Pb-Zn ore deposits are considered to include a relatively low iron content of the deposit as a whole, persistence of primary textures, and high vanadium contents particularly of the galena. Thermal energy is considered to represent the solvent leading to a

solution of the precipitated material without the dition of solvent chemicals. Tectonic heat may give a mperature rise of up to about 100°C, which is nearly ice that necessary for mobilization. R. A. H.

SHER (N. H.). *Review of evidence of genesis of Mt. Isa orebodies.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **16**, 99–111.

The evidence for both the syngenetic and the hydro-ermal modes of origin for the Pb-Zn-Cu ores of Mount a, Queensland, is reviewed. It is considered that most the observed features are capable of interpretation as ing not inconsistent with a syngenetic origin, followed by later rise of isogeotherms due to granite intrusion, deep rial, or both. The main objection to the syngenetic pothesis is the lack of a satisfactory mechanism for the position of mixed sulphides in a marine environment.

R. A. H.

RIP (E.). *The lead deposits of the eastern border of the Caledonides in Sweden.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **16**, 149–159, 4 figs.

Extensive disseminations of galena and blende, together ith pyrite, calcite, baryte, fluorite, and sericite, occur at aisvall and Dorotea in Lapland and at Vassbo in northern alecarlia. The mineralization is found especially where hartzites lie between beds of shale or shaly sandstone ; it considered to be related to low temperature hydrothermal lutions originating from palingenic zones in the inner aledonides. R. A. H.

CHACHNER-KORN (D.). *Bravoitführende Blei-Zinkver-erzungen im Devon und Buntsandstein der Nordeifel.* Neues. Jahrb. Min., Abhandl., 1960, **94**, 469–478, 7 pls.

In both the Devonian Pb-Zn ores of the Eifel and the ew Red Sandstone ores near Mechernich and Maubach he mineralization was the same. It began with dolomite, halybite, bravoite, quartz, and chlorite, continued with lende, and ended with galena, chalcopyrite, tetrahedrite, oulangerite, linnaeite, and millerite. Bravoite is particu-rly common and forms as either spherical gel-bravoite or liomorphic zoned crystals. R. A. H.

RAUME (E.). *Erzvorkommen in den tektonisch hangenden Schichten der Rammelsberger Erzlager bei Goslar.* Neues Jahrb. Min., Abhandl., 1960, **94**, 479–494, 3 figs., 4 pls.

The Pb-Zn-bearing Rammelsberg deposit, near Goslar, pper Harz, is a sedimentary, submarine-hydrothermal ormation in the lower Middle Devonian. In addition to he main orebodies, grains of blende occur in sandstones and ossils are replaced by chalcopyrite. R. A. H.

COLBERTALDO (D. DI) & FRANCESCHETTI (G.). *Il giacimento piombo zincifero di Salafossa nelle Alpi orientali Italiane.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **16**, 126–137, 7 figs.

The blende, galena, pyrite, marcasite, dolomite, and baryte ore deposit of Salafossa, between Sappada and S. Stefano di Cadore, Belluno province, occurs in dolomite rock. The ore solutions are considered to have risen along faults, the ore bodies taking the form of 'mantos' of impregnation and subordinately of replacement.

R. A. H.

RAKIĆ (S.). *Pseudo-Entmischungen von Zinkblende in Magnetkies. Ein Beispiel aus der Pb-Zn-Erzlager-stätten Rudnik (Serbien).* Neues Jahrb. Min., Abhandl., 1960, **94**, 584–590, 1 pl.

Disintegration-like forms of inclusions and recrystallizations of blende in pyrrhotine occur in the contact pneumatolytic-hydrothermal Pb-Zn ore of Rudnik, Serbia. They are interpreted as the pseudo-disintegrations reported by Ramdohr in many ore deposits. R. A. H.

FRIEDRICH (O. M.). *Zur Genesis und Mineralogie einiger ostpersischer Blei- und Zinklagerstätten.* Neues Jahrb. Min., Abhandl., 1960, **94**, 430–468, 5 figs., 6 pls.

Many Pb-Zn deposits occur in veins and fracture zones in the mountainous limestone area east of the Kevir salt-desert, Iran [34°50′N., 57°05′E.]. The mineralization is associated with volcanic rocks which had earlier locally metasomatized the limestone to ferriferous dolomite.

R. A. H.

BORCHERT (H.). *Genesis of marine sedimentary iron ores.* Trans. Inst. Mining & Metall., 1960, **69**, 261–279, 8 figs.

Since trivalent iron is practically insoluble in the presence of oxygen it is contended that the mobilization of iron by weathering solutions in continental regions could not have contributed significantly to the formation of marine iron ores in pre-Devonian times. The mobilization and precipitation of iron must then have been effected within the oceans. The existence of a CO_2 zone at moderate depths in the ocean, where Fe is dissolved to be later precipitated in oxygenated shallow waters, is emphasized. The principal vertical and lateral variations in the iron ore facies are controlled by the sea currents. Physico-chemical control of iron ore formation and the origin of recent glauconite in marine environments are briefly discussed. R. A. H.

GJELSVIK (T.). *The Skorovass pyrite deposit, Grong area, Norway.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **16**, 54–66, 9 figs.

The Skorovass pyrite deposit in central Norway occurs in a relatively flat-lying strongly metamorphosed series of greenschists, representing submarine pyroclastic rocks and basalts. No important structural control of the ore deposition has been found. Wallrock alteration includes chloritization, silicification, carbonatization, and sericitization, and varies considerably in intensity and character. The ore minerals are pyrite, chalcopyrite, and blende: they probably have a hydrothermal-metasomatic rather than a syngenetic origin. [M.A. **14**–480, 482] R. A. H.

Pouba (Z.). *Magnetite ores of Sydvaranger type in Czechoslovakia.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **16**, 164–170, 1 fig.

Bands of magnetite alternating with thick bands of quartz in northern Moravia are compared mineralogically and structurally with the ores of the Sydvaranger [Sør-Varanger?] fjord, Norway. The deposits are probably sedimentary but are related also to submarine volcanic activity. R. A. H.

Caillère (S.) & Kraut (F.). *Les minérais de fer siluriens de la péninsule armoricaine.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **16**, 171–180, 1 fig.

A general description of the Silurian iron ores of the north-east part of the Armorican peninsula is followed by a discussion on the genesis of oolitic iron ores. R. A. H.

Doetsch (G.). *Die Eisenerzlagerstätten von Bilbao.* Neues Jahrb. Min., Abhandl., 1960, **94**, 608–619, 2 figs., 2 pls.

Brief details are given of the iron ore bodies in the Bilbao mining district together with trace element determinations on 60 samples. The primary ore is chalybite. R. A. H.

Mansour (A. O.) & Iskander (W.). *An iron ore deposit at Jebel Abu Tulu, Dar Messeriya, southern Kordofan.* Geol. Surv. Dept., Republic of the Sudan, 1960, Bull. **6**, v + 41 pp., 31 figs., 4 maps.

An iron ore deposit is described from regionally metamorphosed pre-Cambrian psammo-pelitic rocks. Hematite is the dominant constituent, with magnetite occurring mainly as relics within the hematite. Iron values are recorded for 98 chip samples and complete analyses are given for two composite chip samples: the average Fe content is 61·12% (Fe_2O_3 87·40). Probable reserves amount to 35 million tons of ore: the site is accessible and close to a railway. [M.A. **14**–257] R. A. H.

Klemm (D. D.). *Die Eisenerzvorkommen von Dirvik (Anatolien) als Beispiel tektonisch angelegter pneumatolytisch-metasomatischer Lagerstättenbildung.* Neues Jahrb. Min., Abhandl., 1960, **94**, 591–607, 4 figs.

The iron ore deposits of Dirvik, east Anatolia, Turkey, are of pneumatolytic-metasomatic origin. At one locality carbonate and serpentinite are in contact with syenite monzonites giving skarn mineralization. The dominant ore is magnetite with lesser hematite, pyrite, chalcopyrite, etc. The garnet-, pyroxene-mica-, and scapolite-bearing contact rocks are described. R. A. H.

Rose (E. R.). *Iron deposits of eastern Ontario and adjoining Quebec.* Geol. Surv. Canada, 1958, Bull. **45**, 120 pp.

This report deals with geological features of the magnetite and hematite deposits of a region comprising some 16,000 square miles within the Precambrian Grenville province of the Canadian Shield. The iron deposits are divided into the following three classes: magnetite deposits high in titanium, magnetite deposits low in titanium, and hematite deposits. The mineralogy, geochemistry, and origin of the deposits are discussed in considerable detail. Approximately 120 spectrographic analyses are included. R. J. T.

Baker (G.). *Some Australian occurrences of micro-spherular pyrite.* Neues Jahrb. Min., Abhandl., 1960, **94**, 564–583, 4 figs.

Micro-spherular or framboidal pyrite in four Australian ore deposits is similar to that described from Germany, Great Britain, and Spain. Where directly associated with ore minerals of economic value the Australian framboidal pyrite always pre-dates the ore minerals. It is suggested that some such pyrite may be of biogenic origin while other apparently identical examples may be of inorganic origin. [M.A. **10**–215] R. A. H.

Banerjee (Swastik). *Genesis of the chromite ores of Jojohatu, Singhbhum district, Bihar, India, with a note on their mineragraphy.* Proc. Nat. Inst. Sci. India, 1960, **26A**, 31–40, 2 pls.

Chromite occurring as late magmatic residual liquid segregation in the layered ultramafic bodies of Jojohatu has been affected by faulting and shearing. The mineralogy, texture, and paragenesis of the ore minerals are described and a comparative study of the chromite deposits of Jojohatu (Bihar), Sittampundi complex (Madras), and Nausahi (Orissa) given. A. P. S.

Dasgupta (Srikumar). *Chromite deposits near Sukinda, Cuttack district, Orissa.* Quart. Journ. Geol. Min. Met. Soc. India, 1959, **31**, 227–232, 3 figs.

Describes the mineralogy of a chromite ore body and infers it to be an early magmatic segregation. A. P. S.

Mitra (S.). *Mineragraphy of the iron ores of the Daitari (Cuttack district), Orissa, with a note on the paragenesis.* Sci. & Culture, 1960, **26**, 36–38, 3 figs.

Describes optical properties, and textural relations of matite, martite, goethite, magnetite, lepidocrocite, and rite in the iron ores and banded hematite quartzites. eplacements are described as being contemporaneous with e concentration of iron ores from banded hematite uartzite. A. P. S.

LGRAMI (S. A.) & INGAMELLS (C. O.). *Chemical composition of the Zhob Valley chromites, West Pakistan.* Amer. Min., 1960, **45**, 576–590, 3 figs.

The chemical composition of chromites from Hindubaghasai area is discussed on a basis of 2 complete and 22 rtial analyses. Procedures for determination of water, H_2O^{II}, Mn, V, SiO_2, Al_2O_3, TiO_2, Fe, CaO, and MgO in romite are given. A. C. H.

UHA SARKAR (TUSHAR KUMAR) & MUKHERJEE (SATYAMAY). *A note on the magnetic titaniferous iron ores occurring in Jhalda Raj estate, Purulia district, West Bengal.* Quart. Journ. Geol. Min. & Met. Soc. India, 1959, **31**, 49–51, 3 figs.

The paragenesis and textures of magnetite, ilmenite, matite, martite, rutile, and related minerals from neisses, and the pegmatites veining them are described. A. P. S.

LLIOTT (R. A.). *Beneficiation of titanium ores with particular reference to Canadian ores.* Trans. Canad. Inst. Mining & Metall., 1959, **62**, 90–95, 5 figs., 4 tables.

Canadian titanium ores are of three types : titaniferous agnetite, magnetite-ilmenite, and ilmenite-hematite. hotographs are given to show intimate intergrowths of ese minerals. Magnetic separation, flotation, heavy edia, and gravity separation methods can be used to parate the minerals of the ores. G. P.

HAKRABORTY (K. L.). *Mineragraphic study of the vanadium bearing titaniferous magnetites associated with the gabbro-anorthosites of Nausahi, Keonjhar district, Orissa, India—their textural relations and paragenesis.* Proc. Nat. Inst. Sci. India, 1959, **25A**, 262–72, 5 pls.

Describes magnetite, ilmenite-martite, hematite, rutile, goethite, chalcopyrite, pyrite, arsenopyrite, pyrrhotine, cubanite, and covelline found in the titaniferous magnetite rocks associated with gabbro anorthosites. The optical properties of these minerals, etch reactions, reflectance, etc., are detailed and several types of crystallographic and replacement textures in the oxide minerals identified. The formation of the intergrowths in these oxide minerals is ascribed to unmixing and diffusion during the cooling of the ore-rich liquid, based on study of specimens subjected to heat treatment. The sulphide minerals are unrelated to the oxides and are considered to be of later hydrothermal origin. Several excellent photomicrographs illustrate textural features described. A. P. S.

GUSTAVSON (MAGNE). *Den manganholdige siderittmalm i Rubben, Troms.* (An occurrence of manganese-bearing siderite ore in Rubben, Troms, Northern Norway). Norges Geol. Unders., 1960, **211**, 18–25, (English summary).

The ore occurs in a complex of Caledonian micaschists, amphibolites, and limestones. The largest body is 4 to 5 metres thick and possibly 60 metres long. Below a thin oxidized crust the ore consists of a carbonate mineral with some magnetite, garnet, and quartz. Analysis of the pure carbonate gives $FeCO_3$ 85·50, $MnCO_3$ 12·10, $CaCO_3$ 2·00, $MgCO_3$ 0·70, =100·30 ; sp. gr. 3·83. I. W. O.

JANKOVIĆ (S.). *Allgemeine Charakteristika der Antimon-Erzlagerstätten Jugoslawiens.* Neues Jahrb. Min., Abhandl., 1960, **94**, 506–538, 9 figs.

Yugoslavian antimony deposits are classified as : Sb ore ; Sb-As-Hg associations ; Sb-Pb-Zn-Cu associations ; Sb-W ore ; Sb-As-Ni-Co-U associations ; and Sb-Cu-Mo associations. These deposits are connected genetically with Tertiary lavas. The fully differentiated ore solutions formed monometallic Sb deposits, less differentiated ore solutions gave Sb, Hg, As, and W, and weakly differentiated solutions gave predominantly Pb-Zn minerals with some Sb. R. A. H.

EXPERIMENTAL MINERALOGY

IARDINI (A. A.), TYDINGS (J. E.), & LEVIN (S. B.). *A very high pressure–high temperature research apparatus and the synthesis of diamond.* Amer. Min., 1960, **45**, 217–221, 3 figs.

Description of an apparatus capable of sustained nearly ydrostatic pressure of 100,000 atm. concurrent with mperatures exceeding 3000°C is given. An experimental nthesis of diamond from graphite confined between ckel plugs at 156°C under 85,000 atm. pressure is escribed. A. C. H.

[PALATNIK (L. S.) & LANDAU (A. I.)] Палатник (Л. С.) и Ландау (А. И.). Методы исследования многокомпонентных гетерогенных систем [*Methods of study of polycomponent heterogeneous systems*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth. conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 19–37, 10 figs.

The experimental methods of a physico-chemical analysis are grouped into (1) thermal, (2) electric, (3) optical, (4) volumetric analysis, (5) tensiometric analysis, (6) magnetic,

(7) molecular attraction, (8) structural methods. The topo-analytical method of study of polycomponent heterogeneous systems, based on the mathematical background of matrices of concentration of components in the phases of systems, is outlined. The thermodynamic equilibria in the light of the phase rule are discussed and the principal cases are supported by type diagrams, which illustrate the geometrical representation of chemical transformations first developed by N. S. Kurnakov. Complexities of composition and phase are shown to be resolved through the use of barycentric and other types of graphic representation based on topology. S. I. T.

[Belov (N. V.), Molchanov (V. S.), & Prikhid'ko (N. E.)] Белов (Н. В.), Молчанов (В. С.) и Прихидько (Н. Е.). Синтез и строение гидросиликатов, содержащих простые и комплексные катионы тяжелых металлов [*Synthesis and structure of hydrosilicates containing simple and complex cations of heavy metals*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 38–43, 4 figs.

Precipitation of metasilicates in an ammonium medium produced finely dispersed precipitates. Cadmium metasilicate was X-ray amorphous, copper and nickel metasilicates gave X-ray powder photographs with lines suggesting a layer structure. Precipitation in the presence of ethylenediamide produced crops of fine crystals of silicates containing in their formula organic molecules, such as $[CuEn_2]Si_4O_9.nH_2O$, in which En stands for ethylenediamide. Optic and X-ray data and cell dimensions of Cu, Ni, Zn, and Pd compounds are given. S. I. T.

[Toropov (N. A.), Nikogosyan (Kh. S.), & Boĭkova (A. I.)] Торопов (Н. А.), Никогосян (Х. С.) и Бойкова (А. И.). Синтез и исследование некоторых свойств гиллебрандита и других гидросиликатов кальция [*Synthesis and study of certain properties of hillebrandite and other hydrosilicates of calcium*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R), 1958, pp. 44–54, 16 figs.

The initial substances CaO and SiO_2 taken in various proportions and mixed in water, were heated at 250°C in an autoclave. X-ray and thermal data are given for their products: hillebrandite, afwillite, and xonotlite. S. I. T.

[Ryskin (Ya. I.)] Рыскин (Я. И.). Инфракрасные спектры поглощения некоторых гидратированных силикатов кальция [*Infrared absorption spectra of certain hydrated calcium silicates*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 55–62, 3 figs.

The absorption spectra in 7·5–14·5μ intervals vary with composition and structure of the silicates studied. It was possible to identify the artificial $2CaO.SiO_2.xH_2O$ with natural hillebrandite and its product of dehydration with β-Ca_2SiO_4. In hillebrandite there are two hydroxide molecule types: (1) without a hydrogen bond, completely removable in the first stage of dehydration, (2) with a weak hydrogen bond, partly removable in the first stage but completely so in the second. Dehydration disturbs the lattice structure. S. I. T.

[Korzhinskiĭ (A. F.)] Коржинский (А. Ф.). Термооптические исследования минералов группы эпидота и некоторых турмалинов [*Thermo-optical study of minerals of the epidote group and of certain tourmalines*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 97–113, 6 figs.

Four epidotes and five tourmalines, chemical analyses and optical data for which are given, were subjected to thermal and X-ray analyses. It is concluded that the temperatures of dehydration of epidotes are 935–985°C and those of tourmalines are 935–1010°C. Sintering of the powder of tourmalines occurs immediately after dehydration; sintering of epidote powder occurs at 1160–1215°C and is clearly marked by an endothermal effect. The temperature of melting of tourmaline is lowered with increase in the sum of alkalies, alkaline earths, and iron; that of epidotes falls with increase in iron. In tourmaline rich in ferrous oxide, as the result of oxidation at 600–800°, the refraction and birefringence increase sharply. In epidotes, where iron is fully oxidized, this effect is negligible. X-ray and optical studies show that the products of dehydration of tourmaline are mainly mullite with an admixture of maghemite, while those of epidote are anorthite with an admixture of augite and maghemite. S. I. T.

[Ol'shanskiĭ (Ya. I.)] Ольшанский (Я. И.). О взаимодействии кремнезема с фторидами металлов [*On the interaction between silica and metal fluorides*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 114–118, 2 figs.

The formation of immiscible liquids in melts of fluorine-containing silicates was first described by D. P. Grigoriev in 1935 and later by other investigators. These experiments, however, were complicated by the formation of a volatile SiO_4. Successful results of a study of SiO_2+CaF_2 and other fluorides in molybdenum vessels closed by a molybdenum riveted stopper, were achieved by the present author. He thus obtained data relating to the equilibrium fields of the two immiscible liquids in the

se of systems with Mg, Ca, Sr, and Ba fluorides. Immisciility was not recorded in systems with Li, Na, and Al uorides. S. I. T.

EONT'EVA (A. A.)] Леонтьева (А. А.). Вычисление линейной скорости кристаллизации твердых фаз в силикатных расплавах [*The calculation of the linear velocity of crystallization of solid phases in silicate melts*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 119–128, 2 figs.

This is a critical examination of the formulae proposed r the function relating l.v.c. with temperature and of ose for the nucleation rate. The formulae proposed by . M. Cox and P. L. Kirby, F. K. Gorsky, and E. Preston applied to crystallization in glasses are particularly iscussed. S. I. T.

EBEDEV (V. I.)] Лебедев (В. И.). Некоторые результаты изучения каолина и брусита при помощи кривых нагревания под давлением [*Certain results of the study of kaolinite and brucite with the help of heating curves under pressure*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 129–136, 3 figs.

The experiments were carried out in an atmosphere of trogen in a steel autoclave cylinder with self-closing utters constructed by A. V. Babushkin. It is concluded at for simple cases like brucite ⟶ periclase + water (gas) e dehydration curves are analogous to the equilibrium rves, while for more complex cases, like kaolinite ⟶ etakaolinite + water (gas), with formation of a phase n-existing in nature this method allows determination the thermodynamic boundaries of the initial mineral. hus kaolinite clays at one km depth (pressure of the order 250 atm) may be stable up to 600°C. The method of udy of heating curves under pressure may also be applied other minerals, such as serpentine, chlorites, micas, and hers. This conclusion has a bearing on the hypothesis tlined by the present author [M.A. **12**–449, 488, **13**–119]. S. I. T.

ERG (L. G.)] Берг (Л. Г.). Диффузионный метод синтеза минералов [*The method of diffusion as applied to the synthesis of minerals*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 176–179, 8 figs.

Calcite, malachite, crocoite, and azurite crystals were tained by the slow diffusion in a hydrous medium of two component solutions placed in separate vessels which were provided with narrow glass tubes and placed in a tank filled with water. S. I. T.

[MCHEDLOV-PETROSYAN (O. P.) & KINKLADZE (K. A.)] Мчедлов-Петросян (О. П.) и Кинкладзе (К. А.). Калориметрическое исследование процессов гидратации обезвоженных гидросиликатов слоистой структуры [*Calorimetric study of the processes of hydration of dehydrated hydrosilicates having a layer structure*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 180–187, 6 figs.

Experiments on kaolinite, serpentinite, and precious serpentine heated at different temperatures and for various periods of time, were carried out in a specially constructed differential calorimeter. They have shown that the heat of hydration and the specific electroconductivity vary with the temperature and time of heating as well as with the degree of dispersion of the sample. It is also suggested that during heating kaolinite develops metaphases which affect the coordination of active cations producing a crystallochemical activity. The exothermal effect on the heating curve of kaolinite is not produced either by the crystallization of γ-Al_2O_3, or by mullitization ; it is produced by the reconstruction of the lattice prior to the crystallization of mullite. S. I. T.

[OVCHINNIKOV (L. N.) & METTIKH (L. I.)] Овчинников (Л. Н.) и Меттих (Л. И). Связь рудообразования с ассимиляцией по экспериментальным данным [*The connection between ore formation and assimilation according to the experimental data*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 188–200, 13 figs.

About seventy experiments of fusing granite, syenite, basalt, and diabase, were carried out at 1500°C with slow cooling of the product of fusion. The total duration of each experiment was 24–30 hours ; the products were studied under the microscope and, in certain cases, chemically. Three kinds of experiments were carried out : (1) the powder of an igneous rock was mixed in various proportions with a limestone powder in a crucible ; (2) the two powders were placed in contact with each other in the crucible ; and (3) fragments of limestone placed in the powder of an igneous rock. All the experiments showed that on melting granite or syenite mixed with or in contact with limestone and subsequent crystallization of the melt, there was always a separation of pure iron and/or iron oxide minerals, sometimes containing appreciable quantities of Cu, Ni, Co, Mn, Sn, and V. The separated ore was frequently carried upwards by gas bubbles and concentrated

in the upper part of the melt, where native iron was often observed in the form of small globules. S. I. T.

[Khitarov (N. I.)] Хитаров (Н. И.). О взаимодействии олигоклаза с водой в условиях повышенных температур и давлений [*On the interaction between oligoclase and water under high temperature and pressure*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 208–213, 5 figs.

Oligoclase was digested in water in a diffusion autoclave of special construction under 300, 600, and 900 kg/cm² pressure and at temperatures varying from 200° to 600°C. The solvent effects of SiO_2, Al_2O_3, and R_2O show a marked rise at the 350–400°C range and fall at 500–600°C. The region of maximum solubility is preserved with increasing pressures, but the maximum value increases with the increase of pressure. In composition the material dissolved tends towards albite. The results are compared with those of G. W. Morey & W. T. Chen [M.A. **13**–309]. S. I. T.

[Ostrovskiĭ (I. A.)] Островский (И. А.). Эксперименты в некоторых силикатных системах с летучими компонентами [*Experiments on certain silicate systems with volatile components*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 214–220, 6 figs.

The experiments were carried out in an autoclave at temperatures up to 840°C and pressures up to 4000 atm. and with a gas phase consisting of a mixture of water vapour and hydrogen. Dry mixtures of suitable pure components, mixed and ignited, were used. Three types of mineral were synthesized : (1) Hydroxide ferruginous mica, two modifications of which were obtained, (a) aluminium-free, brown mica $K_{0\cdot96}Fe^{II}_{2\cdot73}Fe^{III}_{1\cdot07}Si_{2\cdot97}O_{9\cdot52}(OH)_{2\cdot48}$, α 1·701, γ 1·733, $(-)2V \approx O$, formed at 750 kg/cm², 580–590°C ; (b) fayalite, first synthesized in a 'dry' way and then placed in the autoclave and subjected to the action of volatiles is transformed into magnetite with the separation of silica and hydrogen ; (3) aegirine in an atmosphere of water vapour shows incongruent melting with separation of magnetite, at 875°C and 5000 kg/cm², with a melting point lowered slowly by an increased pressure. Synthetic aegirine gave α 1·769, γ 1·817 and is weakly pleochroic. Various details of the experiments are discussed. S. I. T.

[Sȳromyatnikov (F. V.)] Сыромятников (Ф. В.). Материалы к изучению системы кальцит–вода [*Materials contributing to the study of the calcite–water system*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 221–229, 3 figs.

The experiments were carried out in an exoclave a 400°–800°C and 500, 700, and 1100 kg/cm² pressure. It wa found that the product from a solution of calcite in distille water was portlandite and free carbon dioxide, that th increase of temperature and pressure promotes solution and that both calcite and portlandite begin to melt a 700°C in the absence of carbon dioxide in the atmosphere [M.A. **14**–406] S. I. T.

[Feodot'ev (K. M.) & Shlepov (V. K.)] Феодотьев (К. М. и Шлепов (В. К.). Растворимость солей некоторы элементов в надкритическом водяном паре [*Solubility o salts of certain elements in supercritical water vapour*] Труды пятого сов. эксп. техн. мин. петр. [Trans. fift conf. exper., techn. min. petr.], Изд. Акад. Наук CCC [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 230–236, 4 figs

A special autoclave for the production of supercritica solutions in a range up to 600°C and 450 kg/cm² wa designed, and experiments on the solubility of KCl, NaC and $PbCl_2$ in the gas phase were made. S. I. T.

[Kaĭnarskiĭ (I. S.) & Orlova (I. G.)] Кайнарский (И. С. и Орлова (И. Г.). Взаимосвязь физико-химически свойств равновесных расплавов с тридимитизацие кварца [*The interrelation of physico-chemical properties o equilibrium melts with the tridymitization of quartz*] Труды пятого сов. эксп. техн. мин. петр. [Trans. fift conf. exper. techn. min. petr.], Изд. Акад. Наук CCC [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 359–370, 7 figs

Over seventy equilibrium silicate melts containing CaO MgO, FeO, MnO, BaO, Na_2O, K_2O, and Li_2O, with a SiO content ranging from 34 to 89% were used to study quanti tatively the degree of tridymitization of quartz. Th frequency distribution curves of this degree plotted agains silica and the ratio O : Si in both cases gave skew curve with the maximum against SiO_2 at 86 mol. per cent., an against O : Si ratio at 2·2. The rather complex relation between the degree of tridymitization and the compositio of melts, their viscosity, and surface tension are discussed S. I. T.

[Sinel'nikov (N. N.)] Синельников (Н. Н.). О механизм превращения кварца в тридимит [*On the mechanism o transformation of quartz into tridymite*]. Труды пятог сов. эксп. техн. мин. петр. [Trans. fifth conf. expe techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad Sci. U.S.S.R.], 1958, pp. 371–381, 10 figs.

In the experiments finely ground quartz, with an additio of small quantities of Li_2CO_3 or Na_2CO_3, acting as minera lizers, was heated at temperatures up to 1400°C. Th average grain size of the powder and also the right amoun of a mineralizer are important factors in the process o

ansformation of quartz, which is a two-stage trans-
rmation : quartz ⟶ cristobalite, followed by cristo-
alite ⟶ tridymite. Under certain conditions these two
ages are widely separated, under others they are more
less superimposed. The first case is observed at 1350°C,
ie second at 1000–1200°C. X-ray data are given and
ovide further material for the discussion of the fine
ructure of the products of transformation. S. I. T.

Butt (Yu. M.) & Rashkovich (L. N.)] Бутт (Ю. М.) и Рашкович (Л. Н.). Исследование гидросиликатов магния, полученных гидротермальным синтезом [*The study of magnesium hydrosilicates obtained by means of hydrothermal synthesis*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 322–329, 6 figs.

The results of the experiments are as follows : (1) mag-
sium oxide and ground quartz sand under hydrothermal
eatment at 150–204°C react to form a magnesium hydro-
icate similar to natural serpentine ; (2) similar results are
otained using magnesium carbonate ; (3) under the same
eatment magnesium carbonate and calcium hydroxide
ve rise to calcium carbonate ; (4) synthetic magnesium
drosilicate is not affected by carbon dioxide. S. I. T.

Karyakin (L. I.) & Repenko (K. N.)] Карякин (Л. И.) и Репенко (К. Н.). О минералообразовании при взаимодействии хромошпинелидов с окисью магния при высоких температурах [*On mineral formation at the interaction of chrome spinellides with magnesium oxide at high temperatures*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. experimental techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 382–394, 7 figs.

On heating mixtures of chrome spinel and periclase,
squioxides migrated into periclase and magnesium oxide
grated into chrome spinel. At 1800°C and at less than
o of spinel in the mixture, the spinel is fully assimilated
the periclase. With over 50% of spinel in the mixture
ne of the spinel is left over. With 70% of spinel in the
xture the whole of it is left unassimilated, but with a
anged composition. Details of differential migration of
parate elements are given. S. I. T.

olkonskiĭ (B. V.) & Sadkov (V. I.)] Волконский (Б. В.) и Садков (В. И.). Рентгенографические и петрографические исследования трехкальциевого алюмината в присутствии фторидов в области высоких температур [*X-ray and petrographical studies of three-calcium aluminate in the presence of fluorides at high temperatures*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 415–423, 5 figs.

The effects of NaF, KF, and CaF_2 on $3CaO.Al_2O_3$ are discussed on the basis of thermal and X-ray studies. It is concluded that : (1) NaF and KF began to decompose the tri-calcium aluminate at 800° with the formation of penta-calcium tri-aluminate and CaO, but at 1300° the decomposition is arrested ; (2) the action of CaF_2 is similar but stops at 1000°C ; (3) tri-calcium aluminate in a range of temperatures up to 1500° does not show any polymorphic transformations. S. I. T.

[Lavrov (I. V.)] Лавров (И. В.). Исследование глиноземистой части системы Na_2O–Al_2O_3–SiO_2 [*The study of the alumina part of the system Na_2O–Al_2O_3–SiO_2*]. Труды пятого сов. эксп. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.)], 1958, pp. 462–470, 10 figs.

This study is based on the results of the thermal treatment of fifty mixture samples and two hundred chilled samples belonging to the field of the system in question. The work was done in a specially designed furnace at 1500°–1900°C. Points determined were situated in the field of $Na_2O.11Al_2O_3$. This field is absent in the Schairer & Bowen diagram [M.A. **10**–109, **13**–173], but the authors claim that it occupies the greater part of the corundum field. S. I. T.

[Bron (V. A.)] Брон (В. А.). Диаграмма плавкости системы Al_2O_3–SiO_2–Cr_2O_3 [*Melting diagram of the system Al_2O_3–SiO_2–Cr_2O_3*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 479–483.

A tentative contour-isotherm diagram for the Cr_2O_3-poor region of the diagram Al_2O_3–SiO_2–Cr_2O_3 is constructed. This diagram shows that on the whole addition of Cr_2O_3 to a mixture of Al_2O_3–SiO_2 produces a rise of melting point. Other aspects of this diagram are discussed. S. I. T.

[Arakelyan (O. I.)] Аракелян (О. И.). О твердых растворах системы Na_2O–Al_2O_3–Fe_2O_3 [*On the solid solutions of the system Na_2O–Al_2O_3–Fe_2O_3*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 484–492, 8 figs.

This is a thermal study supported by optical and X-ray studies of the solid phases of the system Na_2O–Al_2O_3–Fe_2O_3. It is found that besides the earlier known phases in this system there occurs a phase $Na_2O.nAl_2O_3.mFe_2O_3$, which is a solid solution of variable composition $Na_2O.11(Al,Fe)_2O_3$. This phase, containing Na_2O and K_2O, is also formed

through a thermal decomposition of solid solutions $Na_2O.Al_2O_3$–$Na_2O.Fe_2O_3$ and $K_2O.Al_2O_3$–$K_2O.Fe_2O_3$.

S. I. T.

[Shchepochkina (N. I.)] Щепочкина (Н. И.). Физико-химическое исследование систем BaO–TiO_2 и FeO–TiO_2 [*A physico-chemical study of the systems BaO–TiO_2 and FeO–TiO_2*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 493–504, 2 figs.

Thermal equilibrium diagrams for these two systems are constructed. In the system BaO–TiO_2 four congruently melting compounds are formed: barium orthotitanate $2BaO.TiO_2$, m.p. 1880°C, barium metatitanate, $BaO.TiO_2$, m.p. 1615°C, barium dititanate, $BaO.2TiO_2$, m.p. 1385°C, and barium tetratitanate, m.p. 1445°C. In the system FeO–TiO_2 three compounds are formed: ulvöspinel, $2FeO.TiO_2$, m.p. 1375°, ilmenite, $FeO.TiO$, m.p. 1365°, ferruginous anosovite $FeO.2TiO_2$, m.p. <1450°C. The composition and the temperatures of the eutectic point, the properties of the solid phases, and their method of formation are given.

S. I. T.

[Toropov (N. A.) & Galakhov (F. Ya.) Торопов (Н. А.) и (Галахов (Ф. Я.). Твердые растворы в системе Al_2O_3–SiO_2 [*Solid solutions in the system Al_2O_3–SiO_2*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 505–510, 3 figs.

A new thermal equilibrium diagram of the binary system Al_2O_3–SiO_2 is constructed. Once more it shows the congruent melting of mullite. [M.A. **12**–414, **14**–487]

S. I. T.

Brauer (G.) & Littke (W.). *Über den Schmelzpunkt und die thermische Dissoziation von Titandioxyd.* Journ. Inorg. Nucl. Chem., 1960, **16**, 67–76, 5 figs.

The melting point of TiO_2 has been determined to lie between 1840° and 1870°C, depending on the oxygen partial pressure, and the liquidus curve of the system TiO_2–Ti_2O_3 has been obtained.

R. A. H.

Rao (C. N. R.), Turner (A.), & Honig (J. M.). [*Some observations concerning the effect of impurities on the anatase-rutile transition.* Journ. Phys. Chem. Solids, 1959, **11**, 173.] Brit. Ceram. Abstr., 1960, abstr. 1036.

A letter. The effects on this transition of 5 atomic % of Sb^{5+}, Al^{3+}, Zn^{2+}, PO_4^{3-}, SO_4^{2-} & Cl^- were studied. All the impurities stabilized the anatase structure.

A. G. C.

Skinner (Brian J.) & Barton (Paul B., *Jr.*). *The substitution of oxygen for sulfur in wurtzite and sphalerite.* Amer. Min., 1960, **45**, 612–625, 1 fig.

The sulfur in wurtzite and blende can be substituted by oxygen. A maximum 0·7 wgt. % of ZnO was found in synthetic blende, compared with the maximum of 1·0 in wurtzite. The unit cell edge of blende is reduced from 5·4093 to 5·4065Å by the addition of 0·7 wgt. % of ZnO.

A. C. H.

Frenzel (G.). *Über die Darstellung von Cu_5FeS_6.* Schweiz. Min. Petr. Mitt., 1960, **40**, 243–251, 8 figs.

Crystals of idaite, Cu_5FeS_6, are artificially prepared and their morphology is described. The powder pattern is given. In nature, idaite forms by alteration of bornite. Three new localities are noted: Mina Cerro Huemul, Malargüe, Mendoza, Argentina; Mina San Martin de Llulluncurá, Valcheta, Argentina; Cherif Abad near Isfahan, Iran. [M.A. **14**–279]

M. W.

Richardson (P. W.) & Hawkes (H. E.). *Adsorption of copper on quartz.* Geochim. Cosmochim. Acta, 1959, **15**, 6–9, 1 fig.

The adsorption of Cu on fine-grained quartz particles of negative surface charge in dilute aqueous Cu solutions, of pH below that at which Cu precipitates as the hydroxide, increases roughly as the square root of the concentration of the Cu in solution.

R. C.

Wasserburg (G. J.). *The solubility of quartz in supercritical water as a function of pressure.* Journ. Geol. 1958, **66**, 559–578.

A theoretical treatment of the solubility of SiO_2 in supercritical H_2O. Thermodynamic equilibrium equations are presented and evaluated for some simple limiting cases in the SiO_2–H_2O system. The reaction $SiO_2+2H_2O=Si(OH)_4$ is shown to be compatible with experimental data from 0·3 to 2 kilobars pressure. An expression is given for the fugacity of solutes as a function of pressure in terms of certain structural parameters and the equation of state of the solvent.

H. L.

Richardson (H. M.). [*Mullite—its formation and stability.* Brit. Ceram. Res. Assoc., 'The A.T. Green Book', 1959, 180.] Brit. Ceram. Abstr. 1960, abstr. 119.

The formation of mullite from pure oxides and natural minerals and the solution of various oxides in mullite are discussed. The stability of mullite in the presence of iron oxides, alkali oxides, MnO, CaO, ZnO, and V_2O_5 is considered.

A. G. C.

Laiman (S.). *Synthesis of brannerite.* Canad. Min., 1959, **6**, 389–390.

Mixtures of UO_2, U_3O_8, or UO_3 with TiO_2 in the molecular proportion $UO_2 : TiO_2 = 1 : 2$ heated in argon at 1400°C for 10 minutes yielded a homogeneous product whose X-ray powder pattern is essentially that of heat-treated brannerite. It is thus concluded that brannerite has the composition UTi_2O_6. R. B. F.

Perloff (A.) & Block (S.). *Low temperature phase transition of colemanite.* Amer. Min., 1960, **45**, 229.

In colemanite the transition between the room temperature $P2_1/a$ phase and the low temperature $P2_1$ phase was found to be reversible. There was no observable change in cell dimensions. A. C. H.

Glasser (F. P.). *On the stability and synthesis of uvarovite, $Ca_3Cr_2Si_3O_{12}$.* Amer. Min., 1959, **44**, 1301–1303.

The maximum stability temperature of uvarovite is 1370 ± 10°C. No appreciable solid solution exists between uvarovite and any other component in the system CaO–Cr_2O_3–SiO_2. Uvarovite can be synthesized at 885° to 1400°C and 1 atm. pressure, and once formed is stable at lower temperatures. B. H. B.

Gentile (A. L.) & Roy (Rustum). *Isomorphism and crystalline solubility in the garnet family.* Amer. Min., 1960, **45**, 701–711.

The solubility relationships among the three garnet groups ugrandite, pyralspite, and rare earth garnets was studied by reacting the components 'dry' and under high water pressures. The main variable was the ionic radius. Between pyralspite and ugrandite very little binary solubility was found. Complete crystalline miscibility exists between the rare earth and natural garnets. Complete miscibility of $3CdO.Al_2O_3.3SiO_2$ garnet structure with both spessartite and uvarovite was found. A. C. H.

Sudo (T.), Satoru (U.), & Iwamoto (S.). *Formation of hydrogarnet by chemical reaction among calcium carbonate, ammonium chloride and some silicates.* Nature, 1960, **188**, 223–224.

Known mixtures (2 : 3 : 2 by weight) of $KAlSi_3O_8$, $CaCO_3$, and NH_4Cl were heated at various temperatures between 100° and 800°C for one hour. Feldspar and calcite persisted to nearly 600°C, wollastonite appeared at about 500°C and a garnet structure formed from about 700°C. Chemical analysis and X-ray powder data indicated a hydrogrossular with a 11·97Å. Heating known mixtures (1 : 1 : 1 by weight) of leuchtenbergite, $CaCO_3$, and NH_4Cl gave periclase and garnet structures at about 600°C. Chemical analysis and X-ray data indicated hydrogrossular (a 12·10Å) and periclase. M. J. Le B.

Breck (D. W.), Eversole (W. G.), Milton (R. M.), Reed (T. B.), & Thomas (T. L.). *Crystalline zeolites. I. The properties of a new synthetic zeolite, type A.* Journ. Amer. Chem. Soc., 1956, **78**, 5963–5971, 12 figs.

A new zeolite, $Na_{12}[(AlO_2)_{12}(SiO_2)_{12}].27H_2O$, has been synthesized from sodium aluminosilicate gels. It is cubic, a 12·32, space group $Pm3m$ [M.A. **15**–97]. Other zeolites synthesized include mordenite, chabazite, erionite, faujasite, and gismondine. Chabazite from Colorado has the composition SiO_2 50·0, Al_2O_3 17·9, CaO 9·2, Na_2O 1·5, K_2O 0·4, H_2O 21·0, [=100·0]. R. A. H.

Koizumi (Mitsue) & Roy (Rustum). *Zeolite studies. I. Synthesis and stability of the calcium zeolites.* Journ. Geol., 1960, **68**, 41–53.

The possible use of zeolites as indicators of low temperature metamorphic facies is complicated by the fact that their stable formation may depend on the presence or absence of their own substance or of others. In the present study Ca-heulandite, wairakite, scolecite, and epistilbite with accessory montmorillonoids were synthesized from 'Ludox' gels under hydrothermal conditions in sealed bombs. Neither laumontite nor phillipsite were synthesized. Different products were obtained by seeding the same gel with different zeolites, and the natural phase often gave results different from those obtained with synthetic gels. The temperature of dissociation and the products at 1000 atm. of H_2O pressure were determined for phillipsite, scolecite, laumontite, heulandite, epistilbite, and wairakite, and the results used to construct a provisional P-T phase diagram. R. E. W.

Regis (A. J.), Sand (L. B.), Calmon (C.), & Gilwood (M. E.). *Phase studies in the portion of the soda–alumina–silica–water system producing zeolites.* Journ. Phys. Chem., 1960, **64**, 1567–1571, 5 figs.

At 100°C and 1 atm. pressure metastable hydroxy-cancrinite, faujasite, and cubic phillipsite disappear before 30 days and leave their stable phases : hydroxy-sodalite, tetragonal phillipsite, orthorhombic phillipsite, and the zeolite Linde A. Analcite, albite, and nepheline hydrate-I appear as decomposition products of Linde A (195°C) and the phillipsites (260°C). Natural conditions in which Linde A might be formed are discussed. Numerous optical data, and 3 chemical analyses of the synthetic phillipsites are given. W. T. H.

Goldsmith (Julian R.) & Graf (Donald L.). *Subsolidus relations in the system $CaCO_3$–$MgCO_3$–$MnCO_3$.* Journ. Geol., 1960, **68**, 324–335, 7 figs.

At 10 kilobars pressure and 500°C there are two single-phase regions which enlarge at higher temperatures. In

addition there are three two-phase regions, two of which extend into the phase triangle from the immiscibility gaps of the $CaCO_3$–$MgCO_3$ binary system and the third of which is related to an immiscibility gap in the $CaCO_3$–$MnCO_3$ binary system. These and an interior triangular three-phase region decrease in size progressively at 600°, 700°, and 800°C, and $CaCO_3$ and $MnCO_3$ become completely miscible at temperatures above 600°C. R. E. W.

Togari (Kenji) & Togari (Susumu). *Conditions controlling the crystal form of calcium carbonate minerals. I. On the influence of the temperature and the presence of magnesium ion.* Journ. Fac. Sci. Hokkaido Univ., 1955, ser. iv, **9**, 55–65, 4 figs., 1 table.

$CaCO_3$ precipitated slowly by reaction of ammonium carbonate and calcium chloride solutions in water yields calcite below 30°C with aragonite in increasing proportion at higher temperatures, the precipitate being nearly all aragonite at 70°C. The presence of small amounts of Mg ion markedly reduces the temperatures at which a certain proportion of aragonite appears. The products were tested by Meigen's reaction and also by X-ray diffractometer. A. P.

Razouk (R. I.), Salen (A. S.), & Mikhail (R. S.). *The sorption of water vapor on dehydrated gypsum.* Journ. Phys. Chem., 1960, **64**, 1350–1355, 5 figs.

Room temperature sorption isotherms, infrared spectra, and X-ray diffraction document in detail the previously established transformations of calcium sulfate. In a vacuum below 400°C gypsum dehydrates to γ-$CaSO_4$, which can transform quickly and reversibly to the hemihydrate; above that temperature it goes to anhydrite. Hemihydrate ⟶ gypsum is slow and anhydrite formed above 400°C re-hydrates even more slowly. W. T. H.

Kinser (Charles A.). *Changes in thermogravimetric curves of calcium sulfate dihydrate with variations in the heating rate.* Prof. Paper U.S. Geol. Survey, 1960, **400B**, B438–439. K. S.

Greenberg (S. A.), Chanz (P. N.), & Anderson (E.). *Investigation of colloidal hydrated calcium silicates. I. Solubility products.* Journ. Phys. Chem., 1960, **64**, 1151–1157, 4 figs.

Solubility products were measured for tobermorite synthesized hydrothermally at 186°C and β-wollastonite dehydrated at 1050°C, as well as colloidal products of various CaO : SiO_2 ratios near 1. The latter give evidence of 'solid solution' of $Ca(OH)_2$ in CaH_2SiO_4. W. T. H.

Sharp (W. E.). *The cell constants of artificial siderite.* Amer. Min., 1960, **45**, 241–243.

Directions are given for the preparation of artificial siderite [chalybite]. The cell constants, space group $R\bar{3}c$, a 4·690±0·002, c 15·370±0·003 and calc. D 3·941 gm/cm³ for the synthetic siderite compared closely with the values for the natural material. A. C. H.

Prosser (V.). *The optical constants of single crystals of hexagonal selenium.* Czech. Journ. Phys., 1960, **B10**, 306–316, (English with Russian summary).

The optical constants of single crystals of hexagonal selenium in the region of the intrinsic absorption edge in polarized light were investigated. The absorption edge for light polarized normal to the optical axis of the crystal is displaced towards longer wavelengths. The absorption maximum of hexagonal selenium for a wavelength of 0·6μ is interpreted as the maximum corresponding to interaction between neighbouring chains; in connection with this position of the absorption edge different modifications of selenium are discussed. [Author's abstract] J. N.

Ringwood (A. E.). *The constitution of the mantle—I. Thermodynamics of the olivine-spinel transition.* Geochim. Cosmochim. Acta, 1958, **13**, 303–321, 8 figs.

The pressure required to produce the olivine-spinel inversion in Mg_2SiO_4 has been estimated by a method based on subsolidus phase equilibria studies in the system Ni_2GeO_4–Mg_2SiO_4. The equilibrium pressure for the olivine-spinel transition at 1500°C is $(1{\cdot}75\pm0{\cdot}55)\times10^5$ bars, equivalent to depths in the mantle of 500±140 km. The increase in density when olivine inverts to spinel is 11±3%. The net effect of possible extraneous factors, e.g., the effect of Fe_2SiO_4 in solid solution, may lower the transition pressure, hence the olivine-spinel inversion in the mantle probably begins at depths less than 500 km. R. C.

Ringwood (A. E.). *The constitution of the mantle—II. Further data on the olivine–spinel transition.* Geochim. Cosmochim, Acta, 1959, **15**, 18–29, 2 figs.

Data on the olivine–spinel transition in forsterite and fayalite have been obtained by subsolidus phase equilibria studies in the system Mg_2SiO_4–Mg_2GeO_4 at 660°C and 30,000 bars, and in the system Fe_2GeO_4–Fe_2SiO_4 at 700°C and 25,000 bars. From this and earlier obtained data an approximate P-T curve has been constructed for the transition in forsterite, and the fayalite–spinel inversion pressure calculated [M.A. **14**–404]. The predicted spinel polymorph of fayalite has been synthesized, it has a density 12% higher than that of fayalite [M.A. **14**–39]. Additional investigations show that, at pressures moderately greater than those required for the olivine–spinel transition, $MgSiO_3$ pyroxene may invert to Mg_2SiO_4 spinel, liberating coesite. Fayalite requires a much smaller pressure than forsterite

o invert to spinel, and because of solid solution effects, he transitions should occur over an appreciable zone, the irst-formed spinels being richer in fayalite. All the phase ransitions studied should occur in the mantle at depths ess than 1000 km. [M.A. **13**–269, **14**–263, 487, and preeding abstract] R. C.

Ringwood (A. E.). *The constitution of the mantle—III. Consequences of the olivine–spinel transition.* Geochim. Cosmochim. Acta, 1959, **15**, 195–212, 2 figs.

The constitution of the mantle is discussed. Seismic lata can be explained by phase changes in a mantle of niform composition approximating garnet-peridotite, xcept immediately below the *M*-discontinuity where it nay grade into dunite-peridotite. Increasing temperature nd pressure at depth result in complex transition henomena dominated by the inversion of olivine to spinel. Pyroxene may break down to spinel plus coesite, and at higher temperatures coesite and garnet may dissolve completely in spinel. Ultimately only one phase is present, an homogeneous highly disordered spinel solid solution chemically equivalent to garnet-peridotite. Data obtained in Parts I and II [preceding abstracts] indicate that the transition should be spread over a wide depth range in the upper 1000 km of the mantle. A 1500°C temperature difference between top and bottom of the transition zone would make the experimental transition range coincident with Bullen's (1947) region *C*. A model for the mantle is suggested. R. C.

Brooks (R. R.). *The use of ion-exchange enrichment in the determination of trace elements in sea water.* Analyst, 1960, **85**, 745–748, 2 figs.

The abundance of Au, Bi, and Cd in sea water is respectively 0·009, 0·017, and $>0·02$ mg per ton. R. A. H.

GEMSTONES

Crumper (L. C.). *The measurement of refractive index by reflection.* Journ. Gemmology, 1959, **7**, 129–138, 2 figs.

A reflectometer is described which has been specifically lesigned for the comparatively rapid determination of the efractive indices of gemstones, particularly those with efractive index above 1·81. The instrument is capable of roviding readings within 0·02 : a high degree of polish on he table facet of the gemstone is essential for accurate eadings. R. A. H.

Bruton (E. M.). *Diamond mining in Guinea.* Gemmologist, 1960, **29**, 121–131, 5 illustr.

The Guinea mines have been worked since 1936 and iamonds amount to 5% of the total exports of the Republic n value. The mines are in the Haute Guinée, and Kankan s the buyers' centre. At Banankoro the author visited a ine where diamonds occur in a 'pay gravel' about a yard hick. The bed-rock is granite and above the diamondierous layer is a 20 ft. layer of sandstone. G. F. A.

Webster (R.). *Testing for electro-conductivity.* Gemmologist, 1960, **29**, 161–169.

Tests were carried out with various types of apparatus o detect electro-conductivity. The efficiency of meters, eon lamps, and telephones was tested and various voltages f current tried. Natural blue diamonds, but not irradiated lue diamonds, were found to be conductive. Other conuctive gem minerals were hematite, much chalcedony (but not jasper), verdite, and most turquoise and synthetic blue spinel also. [M.A. **15**–33, 34] G. F. A.

Gualtieri (J. G.), Katz (M. J.), & Wolff (G. A.). *Gas etching and its effect on semiconductor surfaces.* Zeits. Krist., 1960, **114**, 9–22, 8 figs.

Single crystals of diamond have been etched in oxygen at 200 mm Hg and at 1000°C to give etch-pit triangles on (111) pointing in the same direction as the octahedral plane (positive trigons). [M.A. **14**–337] R. A. H.

[Bartoshinskiĭ (Z. V.) & Gnevushev (M. A.)] Бартошинский (З. В.) и Гневушев (М. А.). О причинах оптической анизотропии алмаза [*On the causes of optical anisotropism in the diamond*]. Минер. Сборник Львовского Геол. Общ. [Min. Mag. Lvov Geol. Soc.], 1958, **12**, 57–66, 15 figs, (English summary).

The study of the birefringence pattern of Yakutian diamonds under crossed nicols showed the following types of patterns : wavy-spotted, bow-line, zonal, sectorial. The last type of pattern bears a resemblance to a pattern shown by a quenched glass. A comparison with ilmenite present in the diamond-bearing kimberlite, which shows the effect of quenching, suggests that this may be the explanation of the anisotropy of diamonds. S. I. T.

Powell (Bernard W.). *First artificial diamonds presented to Smithsonian Institution.* Rocks and Minerals, 1956, **31**, 241–243, 2 figs.

R. S. M.

Ford (R. A.). *Polarized absorption spectrum of ruby between* 14,400 *and* 16,000 cm^{-1} *at* 100°*K*. Spectrochim. Acta, 1960, **16**, 582–587, 1 fig.

R. A. H.

Low (W.). *Absorption lines of* Cr^{3+} *in ruby*. Journ. Chem. Phys., 1960, **33**, 1162–1163, 2 figs.

Detailed analysis of certain lines in the visible spectrum is made, and they are assigned to calculated excited states. W. T. H.

Arnold (H.). *Der Abbau von inneren Spannungen durch Hohlkanalbildung in synthetischen Spinellen*. Zeits. Krist., 1960, **114**, 23–27, 4 figs.

Visible acicular inhomogeneities are reported in synthetic spinels of compositions $MgO : Al_2O_3 = 1 : 2{\cdot}50$ and $1 : 2{\cdot}75$. They are interpreted as voids caused by internal strains due to tempering. R. A. H.

Blalock (J. L.). *Gem sillimanite from Idaho*. Rocks and Minerals, 1956, **31**, 240.

Gem quality, jade-like sillimanite occurs as pebbles and small boulders (up to 34 pounds) on gravel bars in Clear water River, Nez Perce County, Idaho. Predominating colours are cream, golden, and ice-blue. R. S. M.

Richards (R. A.). *Arizona agate hunting*. Rocks and Minerals, 1956, **31**, 279–280.

Occurrences of agate in Arizona and directions for locating them are given. R. S. M.

GEOCHEMISTRY

Vistelius (A. B.). *The skew frequency distributions and the fundamental law of the geochemical processes*. Journ. Geol., 1960, **68**, 1–22.

Previously published data in many cases furnish insufficient basis for either acceptance or rejection of the log-normal distribution of elements. New data are examined from the viewpoint that there are two types of distributions of elements : one is developed at a certain stage of the geochemical process, the other represents the mixed products of many stages. In this paper the probability distribution is given emphasis, in contrast to the Goldschmidt school which attempts to determine the actual distribution of elements. According to the fundamental law proposed by the author, the frequency distribution of all products of natural geochemical reactions has a large positive skewness, which indicates that deposition of small concentrations is usually more stable than the deposition of large concentrations of a given element by the same geochemical process. R. E. W.

Fleischer (M.) & Chao (E. C. T.). *Some problems in the estimation of abundances of elements in the Earth's crust*. Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **1**, 141–148.

A major difficulty in the estimate of abundances lies in assumptions about the relative amounts of the various rock types in the crust. For elements concentrated in mafic rocks, such as Ni and Cr, and for elements concentrated in silicic rocks, such as Ba and Rb, the data available on specific rock types are probably better than the estimates of the relative amounts of the rock types. There is therefore an urgent need for regional estimates of the relative abundance of rock types. R. A. H.

Burns (James R.). *Variation of aluminum, sodium, and manganese in common rocks*. Prof. Paper U.S. Geol. Survey, 1960, **400B**, B164–165.

The variation observed in a statistical study of the abundance of these elements is tabulated under 9 categories —2 igneous, 3 sedimentary, 2 metamorphic rocks, amphibolite, and serpentinite. K. S.

Hanshaw (P. M.) & Barnett (P. R.). *Possible use of boron, chromium, and nickel content in correlating Triassic igneous rocks in Connecticut*. Prof. Paper U.S. Geol. Survey, 1960, **400B**, B170–172, 1 fig.

Preliminary results on the content of B, Cr, and Ni in three basaltic lava horizons are given. K. S.

Turekian (K. K.) & Carr (M. H.). *The geochemistries of chromium, cobalt, and nickel*. Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **1**, 14–26, 6 figs.

A large number of samples have been analysed for Cr, Co, and Ni, using combined neutron-activation and emission spectrographic methods. The results are here summarized and the geochemistry of these elements is discussed. In particular the distribution of Cr, Co, and Ni in coexisting minerals of the Stillwater igneous complex, Montana, and the sources and rates of accumulation in deep-sea sediments were studied. At a contact between a 6 ft. wide dolerite dyke and shale, near Spanish Peak, Colorado, Fe, Ni, and Cr were locally removed from the melt at the contact and enriched in the shale within 5 mm of the intrusive rock. R. A. H.

Ricke (W.). *Ein Beitrag zur Geochemie der Schwefel*. Geochim. Cosmochim. Acta, 1960, **21**, 35–80, 2 figs.

Total S and sulphide S have been determined for 96 minerals and 132 rocks. Quartz is reported to contain up to 0·0095% sulphate S, feldspars 0·022%, muscovites 0·013%, pyroxenes 0·007%, and various orthosilicates up to 0·014%. For each main group of igneous rocks the average total S is nearly 0·03%. On the average, plutonic rocks contain more sulphide S and less sulphate S than their effusive equivalents ; acid rocks contain less sulphide S than basic rocks. From leaching studies it is suggested that sulphate in silicates occurs not only in fluid inclusions but also as replacement of SiO_4 by SO_4. In sedimentary rocks S is present mainly as sulphide in shales, greywackes, and carbonate rocks, and as sulphate in sandstones and pelagic sediments. The S contents of the oceans, common sediments, and evaporites are considered to have originated from degassing magmas. R. A. H.

Griffitts (Wallace R.) & Nakagawa (H. M.). *Variations in base-metal contents of monzonitic intrusives.* Prof. Paper U.S. Geol. Survey, 1960, **400B**, B93–95, 1 fig.

The contents of Cu, Pb, and Zn in monzonitic rocks from 6 areas are tabulated. High metal content around the ore deposits is probably due to leakage from the deposit rather than to original high metal content of the magma.

K. S.

Chao (E. C. T.) & Fleischer (M.). *Abundance of zirconium in igneous rocks.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **1**, 106–131, 10 figs.

The abundance of Zr, based on published and unpublished spectrographic analyses on chemically analysed rocks, shows some marked regional variations. Within each petrographic province the Zr content generally increases with increasing total alkalis from basalt to dacite or trachyte. In plutonic rocks Zr is generally low in gabbros (<100 p.p.m.), low to moderate in diorites and granodiorites (50–200 p.p.m.) and low to moderately high in quartz monzonites and granites (50–700 p.p.m.). [M.A. 15–86] R. A. H.

Flanagan (F. J.), Smith (W. L.), & Sherwood (A. M.). *A comparison of two estimates of the thorium content of the Conway granite, New Hampshire.* Prof. Paper U.S. Geol. Survey, 1960, **400B**, B168–169.

K. S.

Borisenok (L. A.) & Saukov (A. A.). *Geochemical cycle of gallium.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **1**, 96–105, 3 figs.

Most of the Ga in ultrabasic rocks is found in pyroxenes and amphiboles (3–8 p.p.m.). In basic, intermediate, and acid rocks the chief Ga carriers are feldspars (10–25 p.p.m.), but the highest concentrations are observed in muscovites (up to 500 p.p.m.), biotite (to 300 p.p.m.), and hornblende (to 50 p.p.m.). Acid pegmatites show no higher Ga than other differentiates but alkaline pegmatites have higher Ga contents and a high Ga/Al ratio : a notable Ga enrichment occurs in greisens, especially in muscovite, while the topaz contains little Ga (3–5 p.p.m.). In hydrothermal processes Ga is concentrated in blendes, the low temperature types containing up to 0·4%. The average Ga content in sediments is 15 p.p.m., and the Ga content of sea water is 5×10^{-8}%. R. A. H.

Janda (I.) & Schroll (E.). *Geochemische Untersuchungen an Graphitgesteinen.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **1**, 40–53, 4 figs.

Determinations of 24 trace elements in 104 specimens of graphite and graphite schists are summarized and the variations in the contents of Ag, As, B, Be, Bi, Ba, Sr, Ni, Co, Cr, Ge, Cu, Ga, Hg, Mn, Mo, Pb, Zn, Sb, Ti, Sn, Tl, V, and Zr are discussed. R. A. H.

Siroonian (H. A.), Shaw (D. M.), & Jones (R. E.). *Lithium geochemistry and the source of the spodumene pegmatites of the Preissac-Lamotte-Lacorne region of western Quebec.* Canad. Min., 1959, **6**, 320–338, 3 figs., 9 tables.

Spectrochemical analyses for Li have been made on 67 mineral and 45 rock samples from the region ; the main rock types are amphibolite, hornblende monzonite, biotite, granodiorite, biotite muscovite granite, aplite, and pegmatite. Li is concentrated mainly in the biotite and muscovite, and in the rocks it increases progressively in the sequence amphibolite–monzonite–granodiorite–granite, suggesting that the Li is concentrated by magmatic differentiation. The Lacorne granite is the richest of the three granites, with Li 248 p.p.m. (Lamotte 127 ; Preissac 87). Comparison of these Li contents with those of other granites throughout the world shows that this region is a geochemical province of high Li. Commercial spodumene pegmatites are associated mainly with the Lacorne mass, and the authors conclude that these have resulted from fractional crystallization of Li-rich batholithic magmas.

R. B. F.

Hayase (Ichikazu). *The radioactivity of rocks and minerals studied with nuclear emulsion. II. Thorium content of granitic allanites.* Mem. Coll. Sci., Univ. Kyoto, 1954, ser. B, **21**, 171–182, 5 figs., 3 tables.

Granitic allanites examined varied in equivalent thorium content from 0·5 to 1·6%. Variation is found even in the allanites within a single thin section. The thorium content of allanite is peculiar to each granitic mass, but has no

direct relation with the radioactivity the host granite itself exhibits. [M.A. **12**–583 ; see following abstracts]

A. P.

Hayase (Ichikazu). *The radioactivity of rocks and minerals studied with nuclear emulsion. III. Radioactivity of biotite of the Tanakamiyama granite, Shiga Pref., Japan.* Mem. Coll. Sci., Univ. Kyoto, 1955, ser B, **22**, 177–184, 1 pl., 4 tables.

Biotite belonging to the later stage is stronger in radioactivity. The biotite itself is feebler in radioactivity when it contains radioactive inclusions than when these are absent. [See preceding abstract and following] A. P.

Hayase (Ichikazu). *The radioactivity of rocks and minerals studied with nuclear emulsion. IV. Thorium uranium ratio measurement of the minute radioactive minerals by the photographic method.* Mem. Coll. Sci., Univ. Kyoto, 1956, ser. B, **23**, 255–274, 24 figs., 4 tables.

Techniques are described for measuring the thorium/uranium ratio. This may vary within a single grain. [See preceding and following abstracts] A. P.

Hayase (Ichikazu). *The radioactivity of rocks and minerals studied with nuclear emulsion. V. Radioactive behaviour of granites.* Mem. Coll. Sci., Univ. Kyoto, 1957, ser. B, **24**, 121–154, 25 figs., 1 pl., 11 tables.

The distribution of radioactive elements in the various phases of complex granitic bodies and in several of the constituent minerals has been determined. Both zircon and biotite are uranium-rich in earlier stages of magmatic differentiation but have grown thorium-rich in its later stages. [See preceding and following abstracts] A. P.

Hayase (Ichikazu). *The radioactivity of rocks and minerals studied with nuclear emulsion. VI. Radioactivity of some Japanese liparites.* Mem. Coll. Sci., Univ. Kyoto, 1958, ser. B, **25**, 81–87, 5 tables.

Measurements are reported for siliceous volcanic rocks from several localities and for the feldspars, coloured minerals, and groundmass of these rocks. The matrix or glassy part of liparite shows high radioactivity. [See preceding abstracts and following] A. P.

Hayase (Ichikazu). *The radioactivity of rocks and minerals studied with nuclear emulsion. VII. Radioactivity of granitic sphene.* Mem. Coll. Sci., Univ. Kyoto, 1959, ser. B, **25**, 205–213, 6 figs., 2 tables.

The radioactivity of sphene varies greatly within the same rock or even within one crystal. The Th/U ratio seems to be about unity. There is a suggestion of a correlation of colour with radioactivity in sphene, the darker varieties being more radioactive. [See preceding abstracts]

A. P.

Tatekawa (Masahisa). *Spectrographic distribution of minor elements in the quartzes and feldspars contained in granites and pegmatites of the Oku-Tango District, Kyoto Prefecture.* Mem. Coll. Sci., Univ. Kyoto, 1954, ser. B, **21**, 183–192, 1 fig., 4 tables.

Spectrographic analyses for Ti, Al, Mg, Na, Sn, Ca, and Ag are reported for quartz from 14 granites and 12 pegmatites. Similar analyses for Pb, Ba, Sr, Mn, Mg, Sn, V, and Ag are reported for the K-feldspars of most of these rocks and for plagioclase from six granite samples. Both quartz and feldspar of pegmatites are, in general, chemically purer than those of its parent rock (granite). The concentration of Pb in the K-feldspars of pegmatites exceeds that of K-feldspars or plagioclase of granites by a factor of about four. No absolute concentrations are reported, only relative figures. [See following abstract] A. P.

Tatekawa (Masahisa). *The pegmatites of the Oku-Tango district of Kyoto Prefecture researched chiefly from the view-point of trace elements.* Mem. Coll. Sci., Univ. Kyoto, 1955, ser. B, **22**, 199–212, 8 figs., 4 tables.

Two chemical analyses of granite and three of perthite (Na_2O 4·71, 3·52, and 3·21% respectively) from pegmatites are reported. Data presented in tabular form in the previous paper are shown graphically. [See preceding abstract] A. P.

Hatuda (Zin'itiro) & Nishimura (Susumu). *Variation in radioactivity across igneous contacts.* Mem. Coll. Sci., Univ. Kyoto, 1956, ser. B, **23**, 285–295, 12 figs.

Distribution of radioactive matter was measured by radioscope on samples taken along 36 traverses across igneous contacts for distances up to 10 metres on either side of the contacts. Results are shown graphically in radioactive profiles which mostly show more variation on the side of the intrusive rock. Five types of variation are tentatively distinguished. [See following abstract]

A. P.

Hatuda (Zin'itirô) & Nishimura (Susumu). *Variation in radioactivity across igneous contacts (the second report).* Mem. Coll. Sci., Univ. Kyoto, 1958, ser. B, **25**, 115–123, 8 figs.

In this report 24 more radioactive profiles are recorded and 4 types of radioactivity distribution across igneous contacts, related to conditions under which contact

enomena took place, are distinguished. [See preceding stract] A. P.

UTSUMI (TOKUDO). *Distribution of radioactive minerals in the granite of Gyojayama, Kyoto Prefecture, Japan.* Mem. Coll. Sci., Univ. Kyoto, 1958, ser. B, **25**, 89–95, 2 figs., 2 tables.

The relation of radioactive minerals to the other constituents of the granite was determined by the use of nuclear track plates on thin sections of more than 30 mples collected at random over an area of several square lometres. The number of radioactive grains situated in otite or on its boundaries far exceeds the number in uartz or feldspar or on other boundaries. Among the radioactive accessories, zircon and monazite are usual, xenotime re, and allanite absent. A. P.

ISHIMURA (SUSUMU). *Radioactivity around ore-deposits.* Mem. Coll. Sci., Univ. Kyoto, 1958, ser. B, **25**, 139–143, 2 figs., 6 tables.

The distribution of radioactivity has been determined by amination of samples with a radioscope. Results from mines or deposits are reported. It is concluded that) radioactivity in the country rocks is generally higher ar ore deposits, especially in impregnated parts, than at distance, (2) in the ore bodies themselves radioactivity is nerally low, (3) radioactivity within the ore body seems be related to situation but to be independent of assay lues. A. P.

KAI (YASUO), KAWAKAMI (TAKAYA), & KIMURA (YASUSHIRO). *The relation between the minute content of uranium in zircon and its mineralogical characteristics.* Mem. Coll. Sci., Univ. Kyoto, 1959, ser. B, **25**, 247–261, 13 figs., 7 tables.

The uranium contents of 28 representative zircon samples llected from the weathered granite sands of the Tensei ine, Osaka prefecture, were determined by a microuorimetric method and found to range from 0·024 to 318%. There is a poor negative correlation of fluorescence tensity of zircons with their U contents. Correlation of egree of metamictness with U content is attempted. rcons very low in U may have a high degree of metaictness. Hf determinations on 6 of the zircons, 1·10 to 25%, show no correlation with U content. Qualitative ectrographic tests for 34 elements are reported for these zircons and for 5 from other regions. The relations tween colour, U content of zircon, proportions of zircon the granite, and situation within three major portions of e granitic body are shown in a graph. From this consions are drawn as to the evolution of the granitic body. I.A. **14**–376] A. P.

[CHENTSOV (I. G.)] Ченцов (И. Г.). О вхождении урана в некоторые породообразующие минералы [*On the presence of uranium in certain rock-forming minerals*]. Труды Института геологии рудных месторождений, петрографии, минералогии и геохимии [Trans. Inst. Geol. Ore-deposits, Petr. Min. & Geochem.], 1959, **28**, 142–147.

The analyses of minerals fractions of granite has shown that the uranium content of minerals varies from $2{\cdot}1\times10^{-4}$ to 1860×10^{-4}%. Over one-third of the total uranium is found in the accessory minerals, up to one-third in ferric minerals, and under one-third in feldspars and quartz. The determination of leaching percentages of uranium for various minerals has shown that considerable amounts can be removed from minerals without affecting the intactness of their framework. S. I. T.

BELL (KENNETH G.). *Deposition of uranium in salt-pan basins.* Prof. Paper U.S. Geol. Survey, 1960, **354-G**, 161–169.

Evaporite sediments deposited in salt-pan basins are probably the least uraniferous of all rocks because (1) U is scarce in ocean and surface waters, (2) evaporating water generally exists in an oxidizing environment, (3) uranyl chlorides and sulfates and uranyl carbonate complexes are very soluble, and (4) uraniferous evaporite sediments are readily removed by erosion or by leaching. The average uranium content of evaporites is less than 0·00001%. K. S.

WHITE (DONALD E.). *Summary of chemical characteristics of some waters of deep origin.* Prof. Paper U.S. Geol. Survey, 1960, **400B**, B452–454.
[M.A. **14**–44] K. S.

WARD (F. N.), NAKAGAWA (H. M.), & HUNT (CHARLES B.). *Geochemical investigation of molybdenum at Nevares Spring in Death Valley, California.* Prof. Paper U.S. Geol. Survey, 1960, **400B**, B454–456, 1 fig.

Molybdenum is concentrated in salts deposited during evaporation. K. S.

ERICKSON (R. L.) & MARRANZINO (A. P.). *Geochemical prospecting for copper in the Rocky Range, Beaver County, Utah.* Prof. Paper U.S. Geol. Survey, 1960, **400B**, B98–101, 3 figs.
K. S.

HUNT (E. C.), STANTON (R. E.), & WELLS (R. A.). *Field determination of beryllium in soils for geochemical prospecting.* Trans. Inst. Mining & Metall., 1960, **69**, 361–369, 1 fig.

The Be is selectively extracted by dilute nitric acid after

fusion of the sample with ammonium fluoride. Interfering ions are suppressed by the addition of EDTA and *N*,*N*-di(2-hydroxyethyl) glycine [Nervanaid F], and Be is estimated by visual colorimetry after the addition of NaOH and berillon solutions. Soils containing 0·5 to 50 p.p.m. Be can be analysed without preliminary separation. R. A. H.

Debnam (A. H.) & Webb (J. S.). *Some geochemical anomalies in soil and stream sediment related to beryl pegmatites in Rhodesia and Uganda.* Trans. Inst. Mining & Metall., 1960, **69**, 329–344, 6 figs.

Beryllium anomalies up to 600 ft wide were detected in the near-surface horizon of residual soils over beryl pegmatites. Peak values are commonly 10–20 p.p.m. Be, rising to 80–125 p.p.m. immediately over the principal beryl zones, as compared with the 0·5–4 p.p.m. Be in normal soils over barren country rock. The soil over one pegmatite was shown to contain anomalous contents of Li, Rb, Ba, Sr, and Sn as well as Be. In one area stream sediments values of 4–10 p.p.m. Be, compared to the local background of 1 p.p.m., extend for at least 3500 ft downstream from a previously unrecognized pegmatite. Details are given for a rapid colorimetric titration procedure for the field estimation of Be. [See previous abstract] R. A. H.

Griffitts (Wallace R.) & Oda (U.). *Geochemical prospecting for beryllium.* Prof. Paper U.S. Geol. Survey, 1960, **400B**, B90–92, 2 figs.

Analysis of alluvium is effective and cheap for finding districts that contain beryllium-rich rocks. K. S.

Harder (H.). *Das Bor im Kreislauf der Gesteine.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **1**, 10–13.

All basic rocks have low boron contents (5 p.p.m.). In sediments richer in boron (85 p.p.m.) the boron is not equally distributed but is mostly in fine-grained clays. There it is mainly attached to illites which in saliferous clays may have 2000 p.p.m. B, marine clays approximately 100 p.p.m. B, and terrestrial clays about 50 p.p.m. B. The geochemical cycle of boron is discussed. R. A. H.

Van Wambeke (L.). *Contribution à l'étude de la minéralogie, de la géochimie et des méthodes de prospection des carbonatites à pyrochlore au moyen des rayons X.* Bull. Soc. belge Géol., 1959, **68**, 178–225, 19 figs., 4 tables.

The value of X-ray spectrographic examination of carbonatites is exemplified by study of the Lueshe, Kivu, carbonatite [M.A. **14**–154, 356] in which aegirine and zircon are shown to carry niobium. Geochemical and geophysical prospecting of carbonatites is discussed and the part played by the association Nb-Sr in such studies considered. The methods of X-ray spectrographic estimation of Nb are described and evaluated. F. Sch.

Andrieux (C.). *Sur l'origine du strontium dans des formations récifales du sénonien toulonnais.* Bull. Soc. franç. Min. Crist., 1960, **83**, 216–220, 6 figs.

Fossil hippurites in the reef formations of Sainte-Anne d'Evenos, Var, France, contain, in geodes within the fossil, white and bluish or greenish celestine, white and yellow calcite, quartz, and amorphous silica : the bluish or greenish celestine contains traces of Mg, Ca, and Cu. The minerals have been deposited in the order of increasing density from the periphery to the central cavity. Needles and rosettes of rutile are recorded from one specimen. R. A. H.

El Wardani (S. A.). *Marine geochemistry of germanium and the origin of Pacific pelagic clay minerals.* Geochim. Cosmochim. Acta, 1959, **15**, 237–254, 1 fig.

Ge averages 0·05 μg/litre in sea water, 2 p.p.m. in Pacific north-east equatorial eupelagic clays, 0·9 p.p.m. in south equatorial eupelagic clays, and 1·1 p.p.m. in shelf and basin sediments. Biological contribution of Ge to the sediment is negligible. The most abundant marine organisms have no detectable Ge, diatom and radiolaria frustules 0·4 p.p.m. Ge, globigerina ooze and siliceous sponges none. Mineral marine scavengers, quartz, and meteoritic dust contribute no Ge. The coarse non-clay mineral fraction of Pacific north-east equatorial pelagic clays averages 1·2 p.p.m. Ge and the fine clay mineral fraction 3·0 p.p.m. Ge. This and other data suggest that Ge is essentially confined to the clay mineral fraction and is removed from sea water during hydrogenous growth of clay minerals. Ge may thus serve as a tracer for the origin of pelagic clay minerals, and the relative abundance of hydrogenous and lithogenous clay minerals estimated from the Ge content. On this basis about 46% of the clay mineral fraction in Pacific north-east equatorial eupelagic clays is hydrogenous. Shelf sediments, south equatorial pelagic clays, and the coarse fraction of the north-east equatorial pelagic clays are essentially lithogenous in origin since their Ge content is similar to that of igneous rocks. [M.A. **14**–268, 269, 270] R. C.

Canney (F. C.) & Hawkins (D. B.). *Field application of ion-exchange resins in hydrochemical prospecting.* Prof. Paper U.S. Geol. Survey, 1960, **400B**, B89–90, 1 fig.

The technique is described. K. S.

Kleinkopf (M. Dean). *Spectrographic determination of trace elements in lake waters of northern Maine.* Bull. Geol. Soc. America, 1960, **71**, 1231–1242, 3 figs.

Spectrographic determination of trace elements in lake waters was utilized as a reconnaissance prospecting method in northern Maine. The programme was based on the thesis that, in general, trace elements in a lake are an indicator

e average trace-element concentration of the rocks in the ainage area and may point out areas of possible economic terest when applied on a regional basis. Semi-quantitive spectrographic analyses were made for 12 elements evaporated-water residues. Samples were collected from 9 lakes distributed over about 20,000 square miles. No dividual values are given, but elemental frequencies are ven and clusters of lakes with values decidedly greater an the general average are indicated on outline maps.
A. L. A.

RANIER (C.). *Aperçu sur la prospection géochimique du plomb et du zinc.* Bull. Soc. franç. Min. Crist., 1960, **83**, 209–215, 4 figs.

The application of geochemical techniques to prospecting r Pb and Zn is discussed and comments are made on the amination of soils, waters, alluvium, rocks, and vegetion. R. A. H.

AAS BECKING (L. G. M.), KAPLAN (I. R.), & MOORE (D.). *Limits of the natural environment in terms of pH and oxidation-reduction potentials.* Journ. Geol., 1960, **68**, 243–284.

The Eh-pH values of almost all natural environments lie ithin a limited range, and some specific environments lie ithin characteristic and even more limited ranges. In rder of increasing Eh-pH ranges are the environments : ain water, mine water, peat bogs, sea water, rivers and kes, marine sediments, evaporites, and hot springs. The h-pH range of green bacteria is among the most limited, nges increasing through iron, sulfate-reducing, purple, enitrifying bacteria, to thio-bacteria and finally algae, he latter found over wide ranges of Eh-pH values. The ost important reaction, affecting both Eh and pH haracteristics of an environment, is the reductive photoynthesis by algae and coloured bacteria, which may involve ulfate and iron. Oxidative reactions, also important, are nly partly biological. R. E. W.

HAW (W. H. R.). *Studies in biogeochemistry—I. A biogeochemical periodic table. The data.* Geochim. Cosmochim. Acta, 1960, **19**, 196–207, 1 fig.

—— *Studies in biogeochemistry—II. Discussion and references. Ibid.*, 207–215, 1 fig.

A biogeochemical periodic table is presented indicating or each element abundance, geochemical character, ssentialness to enzymes or plants or animals, together with elected appropriate chemical and physical properties. ome aspects of biogeochemical relationships and periodicity re examined and some tentative predictions made. It is roposed as an important generalization that within a eriodic group biological importance tends to parallel oceanic abundance. There are indications that, within a periodic group, toxicity and oceanic abundance are inversely related. R. C.

MILLMAN (ANTHONY P.). *Biogeochemical investigations in areas of copper-tin mineralization in south-west England.* Geochim. Cosmochim. Acta, 1957, **12**, 85–93.

Semi-quantitative spectrographic determinations are given for Pb, Zn, Ag, Sn, and Cu in the leaves and twigs of trees and their underlying soils in an area of Cu-Sn-Pb-Zn mineralization on the borders of Devon and Cornwall. The results are compared with those of earlier work in southern Nigeria and Northern Rhodesia. The biogeochemical method is suitable for detecting Pb, Zn, and Cu mineralization, but not Sn because of the low Sn uptake even from cassiterite-rich soils. Inadequate distribution of trees together with the relatively narrow width of anomalies renders the method unsuitable for prospecting in the area investigated. In tropical areas with wide secondary dispersion of ore metals the method may be more useful. [M.A. **9**–307, **11**–61, **12**–45, 402, **14**–125, 195] R. C.

CANNON (HELEN L.). *Geochemistry of sandstones and related vegetation in the Yellow Cat area of the Thompson district, Grand County, Utah.* Prof. Paper U.S. Geol. Survey, 1960, **400B**, B96–97.
K. S.

SHACKLETTE (HANSFORD T.). *Soil and plant sampling at the Mahoney Creek lead-zinc deposit, Revillagigedo Island, southeastern Alaska.* Prof. Paper U.S. Geol. Survey, 1960, **400B**, B102–104, 1 fig.

Both soil and plant values of metal content accurately reflect the known position of the mineral vein. K. S.

CHAPMAN (ROBERT M.) & SHACKLETTE (HANSFORD T.). *Geochemical exploration in Alaska.* Prof. Paper U.S. Geol. Survey, 1960, **400B**, B104–107, 1 fig., 4 tables.

The results of study of the metal content of soils, plants (38 species), stream sediments, and stream waters are summarized and tabulated. K. S.

BLOSS (F. DONALD) & STEINER (ROBERT L.). *Biogeochemical prospecting for manganese in northeast Tennessee.* Bull. Geol. Soc. America, 1960, **71**, 1053–1066, 5 figs.

Samples of mature leaves and second-year twigs were collected from 36 chestnut oaks (*Quercus prinus L.*) growing above two areas of subsurface manganese mineralization. One of the two areas was later developed into an economic ore-body. Mn, Ba, Fe, and Ni were determined spectrographically for ashes of leaves and twigs and for soil samples

from the foot of each tree. The samples from the area which proved to be of economic value more frequently exceeded the average values for Mn, Ba, and Ni than did those from the other area. Although Ni was not detectable in the surface soil, the appearance of Ni in excess of average in leaf and twig ash was confined almost exclusively to the area which proved to be of economic value, particularly to the trees most closely overlying the subsurface Mn ore body. Nickel in chestnut-oak leaf and twig ash thus seemed to be a fairly reliable guide to Mn-ore. A. L. A.

Ingerson (Earl). *The next decade in geochemistry*. Geochim. Cosmochim. Acta, 1958, **14**, 185–203.

R. C.

HISTORY AND BIOGRAPHY

Menzer (G.). *Max von Laue, 9 Oktober, 1879–24 April, 1960*. Zeits. Krist., 1960, **114**, 162–169, 1 pl.

A brief appreciation of the life and work of Professor Dr. Max von Laue.

R. A. H.

[Ginzberg (A. S.)] Гинзберг (А. С.). Роль академика Д. С. Белянкина в развитии русской и советской петрографии [*The role of the Academician D. S. Belyankin in the development of Russian and Soviet petrography*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 7–18.

This is a succinct account of the scientific achievements of D. S. Belyankin (1876–1953) the prominent Russian petrologist, who left behind him over 400 publications. Besides numerous works on regional petrology and rock-forming minerals, Belyankin was greatly concerned with technical petrography and experimental petrology and with their applications to industrial processes. He dealt with slags, refractories, ceramics, cement, glass, and other artificial products. His best known books are 'Introduction to crystallography and mineralogy' (1934); in collaboration with N. A. Toropov and V. V. Lapin 'Physico-chemical systems of silicate technology' (1949); and with B. V. Ivanov and V. V. Lapin 'The petrography of technical stone' (1952).

S. I. T.

Buschendorf (Fr.). *Paul Ramdohr geboren zu Überlingen am 1 Januar 1890 zur Vollendung seines 70 Lebensjahres*. Neues Jahrb. Min., Abhandl., 1960, **94**, 1-22.

Schormüller (J.). *Verleihung der Würde Dr.-Ing. E.h. der Technischen Universität Berlin an Professor Dr. phil. Paul Ramdohr am 1.1.1955*. Ibid., 30–34.

Schachner-Korn (D.). *Verleihung des akademischen Grades und der Würde eines Dr. rer. nat. h.c. an Prof. Dr. phil., Dr.-Ing. E.h. Paul Ramdohr*. Ibid., 35.

Schneiderhöhn (H.). *Eine mineralogisch-lagerstättenkundliche Amerikareise mit P. Ramdohr im Sommer 1930*. Ibid., 36–48, 2 figs.

The occasion of the 70th birthday of Prof. Paul Ramdohr has been marked by the publication of a Festband in his honour consisting of vol. 94 of Neues Jahrb. Min., Abhandl. issued in two parts containing 81 papers in 1,446 pages together with one portrait and 165 plates. In the above four papers Ramdohr's life and work, at Darmstadt, Clausthal, Aachen, Berlin, and Heidelberg are summarized. There are special tributes from the Universities of Berlin and Heidelberg. A bibliography of 124 items is included in the first paper.

R. A. H.

METEORITES AND TEKTITES

Stoenner (R. W.) & Zähringer (J.). *Potassium-argon age of iron meteorites*. Geochim. Cosmochim. Acta, 1959, **15**, 40–50.

^{41}K and ^{40}A determinations are given for seven specimens from five falls of meteorites. In different samples from a single meteorite K may vary by a factor of several hundreds but A/K ratios remain fairly constant, indicating the improbability of significant amounts of primordial ^{40}A. The calculated ages range from 5 to 13×10^9 years and, making the usual assumptions, the iron meteorites are believed to have the high age of 10×10^9 years.

R. C.

Nininger (H. H.) & Huss (G. I.). *The unique meteorite crater at Dalgaranga, Western Australia*. Min. Mag., 1960, **32**, 619–639, 16 figs.

The Dalgaranga crater [M.M. **25**–157] is smaller than originally reported and meteorite samples collected were not medium octahedrites but mesosiderites and siderites. From the plain around the crater 207 specimens were recovered with a total weight of only 1098 g. Some of the mesosiderites had a structure similar to that of the Steinbach, Bavaria, siderophyre, with the oxidised metallic constituents set in a matrix of silicates in which microscopic grains of sulphide are embedded.

R. A. H.

N DILLA (M. A.), ARNOLD (J. R.), & ANDERSON (E. C.). *Spectrometric measurement of natural and cosmic-ray induced radioactivity in meteorites.* Geochim. Cosmochim. Acta, 1960, **20**, 115–121, 4 figs.

A non-destructive method of analysis of meteorites for ural and cosmic ray induced radioactivity using low el γ-ray spectrometry ; samples must weigh from 0·5 to g or more. Initial results appear to be in agreement h chemical determinations of ^{40}K and ^{26}Al for chondrites l achondrites. The Ussuri (Sikhote-Alin) siderite (1947) appreciable ^{60}Co ; the older falls of Odessa and Canyon blo showed no detectable γ-activity. The rate of pro- tion of cosmic ray induced activities is discussed. A. **10**–400, 514, **11**–269, **12**–107, 251, **14**–128]

R. A. H.

ED (G. W.), KIGOSHI (K.), & ANDERSON (E. C.). *Spectrometric measurement of natural and cosmic-ray induced radioactivity in meteorites.* Geochim. Cosmochim. Acta, 1960, **20**, 122–140, 2 figs.

Methods are described and results presented for the ermination of Ba, Hg, Tl, Pb, Bi, U, and of the isotopic nposition of the stone and the troilite phases of iron teorites by neutron activation analysis. Two groups of ndrites are recognised ; the group containing enstatite ndrites and carbonaceous chondrites is much richer in chalcophile elements than the other group. The nuclear l geochemical implications are discussed. [M.A. **14**–49,]

R. A. H.

FRESNE (ANN). *Selenium and tellurium in meteorites.* Geochim. Cosmochim. Acta, 1960, **20**, 141–148.

e and Te, together with Au, were precipitated from ution with sodium hypophosphite. Te was then deter- ned by the iodotelluride method, and Se by using minobenzidine. Results are given for Se and Te in 22 eorite samples, the average values being Se 7·90 p.p.m. l Te 1·34 p.p.m.

R. A. H.

LLER-KNIEFMEIER (M.) & UHLIG (H. H.). *Nickel analyses of metallic meteorites by the electron-probe microanalyser.* Geochim. Cosmochim. Acta, 1961, **21**, 257–265, 3 figs., 9 pls.

nalyses of Ni in separate phases in nine metallic and stony meteorite are reported. Kamacite composition niform but in kamacite around a schreibersite inclusion is lower. Taenite showed a marked composition dient which increased at the taenite-kamacite interface. Ni content of fine plessite was intermediate but varied n that of the adjacent taenite. These facts are believed ecord with cooling of the original meteorite bodies over ng period of time to a temperature of 300°C or lower, but for a lesser time than that required to produce a uniform composition for taenite or for kamacite near schreibersite inclusions.

R. A. H.

AHRENS (L. H.), EDGE (R. A.), & TAYLOR (S. R.). *The uniformity of concentration of lithophile elements in chondrites—with particular reference to Cs.* Geochim. Cosmochim. Acta, 1960, **20**, 260–272, 1 fig.

The relative deviations of Li, Na, K, Rb, Mg, Ca, Sr, Ba, Al, Sc, Eu, Si, Ti, Zr, Th, and U in published analyses of chondrites are mostly around 5%, indicating that chondrites have come from a source with an exceptionally uniform composition. An ion-exchange technique is described for the estimation of Cs and the K/Cs ratio. In the chondrites the average Cs content is 0·12 p.p.m. and the average K/Cs ratio is 7000. The K/Cs ratio in seven basic igneous rocks is fairly uniform, in contrast to granite, and is similar in magnitude to that in chondrites.

R. A. H.

KRINOV (E. L.). *Some considerations on tektites.* Geochim. Cosmochim. Acta, 1958, **14**, 259–266, 2 figs.

Brief review of the results of tektite research in the U.S.S.R. with speculative discussion on origin of tektites. L. J. Spencer's meteorite impact theory is favoured.

R. C.

RINEHART (J. S.). *Impact effects and tektites.* Geochim. Cosmochim. Acta, 1958, **14**, 287–290.

R. C.

VARSAVSKY (C. M.). *Dynamical limits on a lunar origin for tektites.* Geochim. Cosmochim. Acta, 1958, **14**, 291–303, 5 figs.

Computations are made of the distribution of lunar impactites, if they exist, and the shape and size of their regions of fall on the earth's surface.

R. C.

CASSIDY (W. A.). *Achondritic investigations and their bearing on the origin of tektites.* Geochim. Cosmochim. Acta, 1958, **14**, 304–315, 6 figs.

Tektites may have originated from a planet with a chondritic centre, an achondritic subcrust, and a tektitic crust, the tektitic outer layer being completely liquid when the planet disrupted [M.A. **13**–362, 363]. The structure of the planet and compositional variations in achondrites are explained by processes due directly or indirectly to liquid immiscibility in their parent magma.

R. C.

CHAPMAN (D. R.). *Recent re-entry research and the cosmic origin of tektites.* Nature, 1960, **188**, 353–355, 1 fig.

Re-entry aerodynamics assign a cosmic origin to tektites,

and point firmly at the moon as somehow being involved in the act of hurling tektites to the earth. M. J. Le B.

Tilton (G. R.). *Isotopic composition of lead from tektites.* Geochim. Cosmochim. Acta, 1958, **14**, 323–330.

The isotopic composition of Pb in three tektites and one sample of Libyan Desert glass is similar to that of modern terrestrial Pb. The concentrations of U, Th, and Pb have been determined for one of the tektites (an australite); the U/Pb and Th/Pb ratios are most readily explained by Pb-Th-U differentiation during argillaceous sedimentary processes. R. C.

Pinson (W. H., *Jr.*), Herzog (L. F.), Fairbairn (H. W.), & Cormier (R. F.). *Sr/Rb age study of tektites.* Geochim. Cosmochim. Acta, 1958, **14**, 331–339, 1 fig.

Rb and Sr determinations are given for 8 tektites from Australia (2), Bohemia (1), Indo-China (3), and the Philippines (2); K determinations are given for 6 and Sr isotope ratio analyses for 7 of the tektites. Data suggest a common source for the tektites but, alone, are inconclusive with regard to a terrestrial or extraterrestrial origin although indirectly supporting the latter. Contrary to the authors' earlier report [M.A. **34**–133] no radiogenic ^{87}Sr was detected and the tektites are probably very young, geologically zero, too young to be dated by the $^{87}Sr : ^{87}Rb$ method. R. C.

Cohen (A. J.). *Trace element relationships and terrestrial origin of tektites.* Nature, 1960, **188**, 653–654.

The partial volatilization of component oxides during formation of tektite glass is discussed. M. J. Le B.

Taylor (S. R.) & Sachs (Maureen). *Trace elements in australites.* Nature, 1960, **188**, 387–388.

Emission spectrochemical methods are used on 14 australites. The data obtained are consistent with derivation from a quartz-shale mixture. The Cr, Ni, and Co values lend no support to derivation from meteorites or the moon. M. J. Le B.

Cohen (A. J.). *Germanium content of tektites and other natural glasses : implications concerning the origin of tektites.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **1**, 30–39.

The Ge contents of all the tektites studied (except the Ivory Coast tektite) are too low to be compatible with a terrestrial origin, but are of the same order of magnitude as the Ge contents of the non-magnetic portions of three chondrites and an achondrite. Libyan Desert glass is considered to be terrestrial as its Ge content is almost identical with that of local rocks. Brazilian quartz and intergrown topaz had 2·32 and 29·1 p.p.m. Ge respectively, further confirming the preferential substitution of Ge^{4+} for Si^{4+} in the least-linked silicate tetrahedra. [M.A. **12**–424, **14**–268] R. A. H.

Wright (Zelma). *A trip for Texas tektites.* Rocks and Minerals, 1960, **35**, 564.

Four translucent, dark green tektites were collected near Bedias, Grimes County, Texas. R. S. M.

Beals (C. S.), Innes (M. J. S.), & Rottenberg (J. A.). *The search for fossil meteorite craters.* Current Sci., 1960, **29**, 205–218, 249–261, 12 figs.

Based on a survey of results on search for fossil meteorite craters, it is suggested that several circular crater-like structures in various parts of the world, which may be detected by a study of aerial photographs, may perhaps be fossil craters formed by meteoric impacts. Contains excellent description of some investigated meteoric craters. A. P. S.

MINERAL DATA

Nickel (Ernest H.). *The occurrence of native nickel-iron in the serpentine rock of the Eastern Townships of Quebec province.* Canad. Min., 1959, **6**, 307–319, 8 figs., 4 tables.

Native nickel-iron occurs as grains 10–100μ diam. in the serpentine of the serpentinized asbestos-bearing dunites and peridotites which extend for about 40 miles in the Eastern Townships of Quebec. The nickel-iron has the composition 71·0% Ni, 25·3 Fe, 3·5 Co, and 0·2 Cu. The alloy is single-phase with a cubic F lattice and a 3·551–3·555Å. Measured specific gravity (corrected for some chrysotile) 8·58. The nickel-iron appears to have been formed, along with magnetite, as the result of the breakdown during serpentinization of Ni-bearing olivine and enstatite. R. B. F.

Fleischer (Michael). *Studies of the manganese oxide minerals.* Amer. Min., 1960, **45**, 176–187, 2 figs.

Wadsley's formula [M.A. **12**–93, 328] for psilomelane, $(Ba, H_2O)_4Mn_{10}O_{20}$), was verified by a study of 14 chemical analysis. X-ray study of the dehydration products shows that water is lost zeolitically up to 500°C. A. C. H.

Rao (Bhaskar A.). *A probable kreittonite.* Current Sci., 1959, **28**, 485.

Records X-ray and optical data of kreittonite from pegmatites of Acari, Rio Grande, Brazil. A. P. S.

Lapin (V. V.), Kurtseva (N. N.), & Ostrogorskaya (O. P.)] Лапин (В. В.), Курцева (Н. Н.) и Острогорская (О. П.). К минералогии высокотитанистых шлаков [*On the mineralogy of titanium-rich slags*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.] Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 273–284.

Chemical analyses, X-ray and optical data are given for nosovite and sesquioxide of titanium (solid solution), eparated from titanium-rich slags. Three samples of nosovite have shown an excess of TiO_2 over the calculated i_2TiO_5, and one sample has shown an excess of Ti_2O_3. t is concluded that in the structural formula of anosovite $l_8B_4O_{20}$ in the position *A* Ti^{4+} also occurs. A certain mount of V_2O_3 is also in the lattice. The sesquioxide of itanium (solid solution) represents an independent phase. M.A. **15**–45] S. I. T.

Mukherjee (Satyamay). *Ferrian chromite and its oxidation.* Quart. Journ. Geol. Min. Met. Soc. India, 1959, **31**, 123–125.

A chromite is described with physical properties intermediate between chromite and magnetite ; the existence of solid solution of $FeO.Cr_2O_3$ and $FeO.Fe_2O_3$ stable at rdinary temperatures is suggested. A. P. S.

Wittle (A. W. G.). *The nature of davidite.* Econ. Geol., , 1959, **54**, 64–81, 14 figs.

A wider variety of davidites is found in the Precambrian ocks in the northeast sector of South Australia than anyhere else in the world. The question is raised as to whether the generally accepted description and composition of davidite is valid. X-ray diffraction analyses, sing iron-filtered cobalt radiation, were attempted on all arieties of davidite from South Australia. No recognizable rystal pattern was observed. The purest davidite (from egmatites) contains swarms of minute rutile crystals naking separation of pure davidite for analysis impossible. hemical analyses of davidite, by D. Bowditch and J. D. Hayton, are as follows :

	A	B	C	D_2	D_5	E	F	G
O_2	5·6	2·3	2·8	8·8	4·3	3·6	7·7	1·5
$n_2O_3+ThO_2$	8·2	11·6	6·4	7·0	11·3	8·8	7·6	12·8
iO_2	49·8	50·7	53·6	47·0	53·0	49·8	45·3	49·0
e_2O_3	20·7	29·8	17·6	31·3	25·3	29·9	32·1	6·8
eO								23·9
r_2O_3	0·7	0·7	1·5	0·6	0·4	1·1	1·3	}
$_2O_5$	0·4	1·2	6·1	1·5	1·8	2·7	0·6	} 3·1
l_2O_3,ZrO_2, etc.	4·3	1·7	4·2	0·7		1·1	2·0	}
bO	1·0	0·5	0·9	0·9	0·7	0·7	1·5	0·1
n_3O_4								0·3
aO								0·7
iO_2	4·6	0·2	4·4	0·9	1·4	1·3	0·2	0·1
gn. loss	3·6	0·3	0·9			nil	0·5	
$_2O(+100°C)$				1·2	1·2			
sol. in HF				nil	0·5			

Davidite : A, from quartzite, Spring Hill ; B, from pegmatite, Billeroo ; C, from lodes, Mt. Victoria ; D_2, from David Lode, Radium Hill ; D_5, from Whip Lode, Radium Hill ; E, from pegmatite, Broken Hill ; F, from calcsilicate rock, Mt. Isa ; G, from pegmatite, Mt. Pleasant. G. S. C.

Katz (Gerald). *Jacobsite from the Negev, Israel.* Amer. Min., 1960, **45**, 734–739, 1 fig.

The specimen, from a boulder 26 miles N. of Eilat, is deep black in colour, with brownish black streak, strongly magnetic, H.6—. Chemical analysis gave Fe 14·6, Mn 29·0% ; spectrochemical analysis showed small amounts of Si, Ba, Al. Polished sections and X-ray diffraction data (given) showed admixture with hematite and goethite ; a 8·51±0·01Å. A. C. H.

Levinson (A. A.) & Borup (R. A.). *High hafnium zircon from Norway.* Amer. Min., 1960, **45**, 562–565.

Zircon occurring in two clusters, 4–5 mm across, protruding from a crystal of thortveitite from Iveland, Norway, gave by X-ray fluorescence analysis HfO_2 22, 24, ZrO_2 47, 42, Fe_2O_3 4, 4, Y_2O_3 1–3, 2–4% with Hf : Zr 0·54, 0·65. No U nor Th was detected ; only traces of Be and Sc were found. The presence of Hf and Zr within the structure of the thortveitite, not as inclusions of zircon, was confirmed. A. C. H.

Levinson (A. A.) & Borup (R. A.). *New data on the hafnium, zirconium and yttrium content of thortveitite.* Amer. Min., 1960, **45**, 712–715.

Reddish brown thortveitite from Iveland, Norway, with which high hafnium zircon was associated [preceding abstract], has Hf : Zr = 1·0 ; grayish brown thortveitite from Iveland, and a specimen from Befanamo, Madagascar have Hf : Zr = 0·6 and 1·2 respectively. A. C. H.

Rao (Umamaheswara G. V.), Krishnaswamy (R.), & Rao (Nagabhushana Y. V.). *Cyrtolite from a pegmatite in Bhunas, India.* Journ. Sci. Industr. Res., India, 1960, **19A**, 385–389, 3 figs.

Metamict cyrtolite in intimate association with veinlets of uraninite is described as a minor mineral in pegmatite. The sp. gr. is 3·71, mean refr. ind. 1·82±0·02 ; chemical analysis gave SiO_2 29·00, Al_2O_3 3·77, Fe_2O_3 2·27, CaO 1·71, PbO 0·83, ZrO_2 45·80, P_2O_5 0·67, U_3O_8 1·86, ThO_2 2·21, Ce_2O_3[$(Ce,La)_2O_3$,$(Y,Er)_2O_3$,H_2O] 3·96, ign. loss 7·70, [=99·78]. Powder patterns before and after heat treatment are given. A. P. S.

Rao (Bhaskara A.). *Remarks on pinguite.* Current Sci., 1960, **29**, 16–17.

Pinguite is classified as a variety of chloropal on the basis of comparative X-ray study. A. P. S.

Drysdall (A. R.) & Newton (A. R.). *Blue asbestos from Lusaka, Northern Rhodesia, and its bearing on the genesis and classification of this type of asbestos.* Amer. Min., 1960, **45**, 53–59.

Blue slip-fibre asbestos occurs as a stockwork of veins in a semi-calcareous host rock. Chemical analysis (one of two independent analyses) SiO_2 56·10, Al_2O_3 4·51, Fe_2O_3 13·67, FeO 1·77, MnO 0·02, MgO 10·40, CaO 0·48, Na_2O 4·95, K_2O 0·23, H_2O+ 5·18, H_2O- 2·74, TiO_2 0·29, CO_2 0·08, P_2O_5 0·07, =100·49 shows it to be magnesioriebeckite [M.A. **14**–144]. Geological evidence indicates a metasomatic origin ; the occurrence is similar to one in Bolivia [M.A. **10**, 242] L. G. B.

Neuvonen (K. J.) & Vesasalo (Arvo). *Pollucite from Luolamäki, Somero, Finland.* Bull. Comm. géol. Finlande 1960, **188**, 133–148, 2 figs., 8 tables.

The first discovery of pollucite in Finland is described. It was found at Luolamäki in pegmatite as two large crystals, about 2 metres diam., without crystal faces. The mineral is intersected by many veinlets, some composed of cryptocrystalline muscovite, some of spodumene, a few of petalite. The main associated mineral is petalite with quartz and albite ; apatite is also abundant. In addition there are beryl, cleavelandite, microcline, laumontite, analcite, and, as alteration products, kaolin and montmorillonite. The optic properties of most of these minerals are given. For pollucite : n_C=1·5142, n_D=1·5172±0·0005 20°C, $n[?n_F]$=1·5223 ; sp. gr. 2·832±0·004 ; a 13·688±0·003Å. Analysis gave : SiO_2 45·60, TiO_2 0·003, Al_2O_3 17·60, Fe_2O_3 0·01, MnO 0·03, MgO 0·00, CaO 0·00, Na_2O 1·65, K_2O 0·01, Li_2O 0·009, Rb_2O 0·73, Cs_2O 32·43, P_2O_5 0·41, H_2O+ 1·91, H_2O- 0·00, = 100·392. X-ray powder data are tabulated, and the reflections observed fit well with the extinctions of the space group *Ia3d*. Small microcline spheres in the montmorillonite zone contain 2·98% Rb_2O, in the coarse microcline perthite 1·51%. Petalite from Luolamäki was described earlier [M.A. **10**–288] ; revised figures for the alkalis are given here : Li_2O 3·95, Na_2O 0·78, K_2O 0·30. V. M.

Eskola (Pentti). *Laumontite in Finland.* Indian Min., 1960, **1**, 29–41, 8 figs.

Laumontite from Finland with α 1·509, γ 1·521, 2V 30° (variable) and composition SiO_2 51·57, Al_2O_3 22·80, Fe_2O_3 0·24, MgO 0·11, CaO 10·43, Na_2O 0·92, K_2O 1·09, H_2O 12·98, [=100·14] is described. Analyses of laumontite-bearing rocks are detailed and the dehydration curve of the mineral is given. A. P. S.

Heinrich (E. W.) & Corey (A. F.). *Manganian andalusite from Kiawa Mountain, Rio Arriba County, New Mexico.* Amer. Min., 1959, **44**, 1261–1271, 3 figs., 5 tables.

Andalusite (var. viridine), containing 4·5% Mn_2O_3, 3·0% Fe_2O_3, occurs with kyanite and hematite in Precambrian quartzite at Kiawa Mountain, Rio Arriba County, New Mexico, U.S.A. The presence of Mn^{3+} and Fe^{3+} imparts an extraordinary and variable pleochroism ranging from emerald green to golden yellow to pink. Optical properties are compared with Swedish viridine and ordinary andalusite and X-ray diffraction data are given. Of the three Al_2SiO_5 minerals, andalusite shows the greater ion substitution compared with sillimanite and kyanite. B. H. B.

Prider (Rex T.). *Viridine from Mt. Ragged, W. Australia.* Indian Min., 1960, **1**, 42–47, 2 figs.

Viridine has α 1·649 (yellow-green), β 1·652 (emerald green), γ 1·660 (golden yellow) ; absorption $\gamma > \alpha > \beta$, $2V_\gamma$ 59°–69°, $r>v$. Chemical analysis by H. W. Wheeler gave SiO_2 35·71, TiO_2 0·17, Al_2O_3 58·38, Fe_2O_3 2·21, Mn_2O_3 3·67, [=100·14] ; sp. gr. 3·19. Identification was confirmed by X-ray data. Linear variation of refractive indices with $Mn^{III}+Fe^{III}$ as indicated by Winchell is confirmed. A. P. S.

Toler (L. G.) & Hower (John). *Determination of mixed layering in glauconites by index of refraction.* Amer. Min., 1959, **44**, 1314–1318.

Measurements on seventeen glauconite samples show that a linear inverse relationship exists between the refractive index, γ, and the percentage of randomly interstratified expandable layers in the structure. From zero to about 40% expandable layers γ varies from 1·64 to 1·58. As the iron content increases γ increases, and the percentage of expandable layers decreases. B. H. B.

Sahama (Th. G.). *Identity of calcium rinkite and götzenite.* Amer. Min., 1960, **45**, 221–224.

From X-ray powder data it is concluded that calcium rinkite and götzenite represent the same species. [M.A. **14**–60] A. C. H.

Huang (W. T.). *Occurrences of eucolite in northern Hudspeth County, Texas.* Canad. Min., 1959, **6**, 399–402, 2 figs.

The occurrence at Miller Mountain is in Tertiary nepheline-syenite. The eucolite is yellowish brown, in subhedral to euhedral crystals up to 3·5 mm diam., with ω 1·588, ε 1·594, sign -ive [contradictory]. This occurrence is similar to that described for eucolite in an adjacent New Mexico locality [Clabaugh (S.E.), Bull. Geol. Soc. America, 1949, **60**, 1879]. The other occurrence is in Precambrian nepheline syenite at Pump Station Hills. The mineral is found only in float as pale yellow anhedral grains with ω 1·658, ε 1·636, uniaxial negative, the high indices being possibly due to Cs content. R. B. F.

ON KNORRING (O.) & DYSON (P.). *An occurrence of genthelvite in the younger granite province of Northern Nigeria.* Amer. Min., 1959, **44**, 1294–1298.

Genthelvite occurs as granular xenolithic 'knots' in an albite vein in albite-biotite granite and also nearby as scattered, laterite-coated grains in a pegmatitic contact zone between two albite-biotite granites. It is purplish-pink, sp.gr. 3·62±·01 ; n 1·745±·002, with a composition of very nearly $Zn_3FeBe_3Si_3O_{12}S$. Chemical analyses of this genthelvite and an associated protolithionite are given, and X-ray diffraction data for the genthelvite. B. H. B.

HUTTON (C. O.). *An occurrence of pseudomalachite at Safford, Arizona.* Amer. Min., 1959, **44**, 1298–1301.

Pseudomalachite, a basic copper phosphate, has been identified in heavy mineral concentrates from metasomatized latites and andesites from Safford, Graham County, Arizona. X-ray powder data are given ; α (pale green) 1·791±0·002, β 1·856, γ (green) 1·867, $2V_\alpha$ 48° ; sp. gr. 4·32±0·02. B. H. B.

OWENS (J. P.), ALTSCHULER (Z. S.), & BERMAN (ROBERT). *Millisite in phosphorite from Homeland, Florida.* Amer. Min., 1960, **45**, 547–562, 6 figs.

The major components in the aluminium phosphate of the Bone Valley Formation of west-central Florida are millisite and crandallite. The minerals occur as a microcrystalline intergrowth composing the altered phosphorite. Millisite rather than the structurally related wardite is found in the Florida material. X-ray data show that the unit cell of millisite has a 7·00, c 19·07Å differing from that of wardite. Aggregate index of refraction for Florida millisite was found to be 1·63 and for Florida crandallite 1·59–1·61. A. C. H.

LEO (G. W.). *Autunite from Mt. Spokane, Washington.* Amer. Min., 1960, **45**, 99–128, 8 figs.

Unusual quality (flakes 1 inch diam.) autunite is found at the Daybreak mine near Mt. Spokane, Washington. The petrography of the area is described. The mineralogy of autunite including the hydration states, optical character in various hydration states, chemical analysis, spectrographic analysis, differential thermal analysis, thermogravimetric analysis, cation exchange capacity, and X-ray powder data is studied and the origin of the deposits is discussed. A. C. H.

VAN TASSEL (R.). *Autunite, apatite, delvauxite, évansite et fluellite de la région de Visé.* Bull. Soc. belge Géol., 1959, **68**, 226–248, 1 fig., 1 pl.

At Richelle, Belgium, dissolution breccias in Palaeozoic limestone show strongly fluorescent autunite associated, even in the same crystal, with non-fluorescent torbernite [M.A. **14**–341]. Analysis gave UO_3 58·18, P_2O_5 14·88, CuO 5·12, CaO 2·93, H_2O 13·71, insol. 5·29, =100·11. The phase meta-I is present in situ. X-ray powder data are tabulated. Fine small fluorapatite crystals, of tabular and bipyramidal habit, show seven forms. Delvauxite occurs as vitreous coating in small geodes. Nearby, at Argenteau, minute autunite plates are found in phosphate-rich breccia. Fluorescent amorphous nodules and veinlets are identified as evansite (n 1·490, sp. gr. 1·96). Minute colourless crystals (0·05–0·2 mm) of fluellite (α 1·476, γ 1·506, sp. gr. 2·12) are compared with fluellite from Stenna Gwyn and Bavaria [M.M. **30**–620, M.A. **9**–258]. X-ray powder spacings are given. Chemical analysis shows a fairly high phosphate content (20·6%) which can scarcely be due to impurities. F. SCH.

VAN TASSEL (R.). *Strengite, phosphosidérite, cacoxénite et apatite fibroradiée de Richelle.* Bull. Soc. belge Géol., 1959, **68**, 360–368, 1 pl.

Phosphate-rich breccias in Palaeozoic limestone at Richelle, Belgium, show minute fibroradiated globules of strengite ($n \approx 1{\cdot}737$, sp. gr. <2·9), phosphosiderite ($n \approx 1{\cdot}717$, sp. gr. <2·9), cacoxenite (ε ≈1·652, ω 1·600, sp. gr. <2·9) and fluorapatite. Small cavities are frequently lined with a brown coating composed of amorphous iron phosphate (delvauxite, $n > 1{\cdot}60$), goethite and β-FeO.OH. The hydrated ferric oxides are recognized by their X-ray powder pattern [M.M. **32**–545]. Yellow amorphous globular or vermicular iron phosphates are regarded as richellite. F. SCH.

BOTHWELL (D. I.), DAVIS (R. J.), & MOSS (A. A.). *A bismuth-bearing variety of bindheimite.* Min. Mag., 1960, **32**, 664–666.

Chemical analysis of a 'bismuthic ochre' (A) from Otjimboyo East, Karibib, South West Africa, together with an X-ray powder photograph, showed it to be a well-crystallized, fibrous, bismuth-bearing bindheimite, with a 10·4480±0·0004Å and fibre axis [110]. A bindheimite (B) from Endellion, Cornwall, was also analysed. The bismuth-bearing bindheimite may be pseudomorphous after a fibrous Bi-bearing Pb-Sb mineral such as kobellite. Details are given of the chemical techniques used.

	PbO	Bi_2O_3	Sb_2O_5	Fe_2O_3	FeO	As_2O_5	Res.	Ign. loss	Total
A	41·1	9·7	30·0	3·0	—	0·1	8·0	4·5	97·6
B	43·0	nil	43·7	—	2·3	0·5	1·7	8·2	99·4

A includes CaO 1·0, Na_2O 0·2. [M.M. **30**–102 ; M.A. **2**–459, **9**–36, **11**–474] R. A. H.

FAURE (HUGUES), GREIGERT (JACQUES), & MARTINET (BERTHE). *Occurences d'alunite au Soudan et au Niger.* C.R. som. Soc. géol. France, 1959, 175–176.

Three beds of alunite have been recognized in the Sudan and on the Niger. They lie at or just above the base of the 'Continental terminal'. The material is described and chemical analyses given: (A) and (C) from the Niger, (B) from Sudan.

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	TiO_2
A	1·40	38·25	tr.	tr.	tr.	tr.	tr.	1·30	9·15	nil
B	tr.	38·30	tr.	tr.	tr.	0·30	0·50	4·40	5·50	0·15
C	0·20	38·50	tr.	tr.	tr.	0·80	nil	1·10	9·30	nil

	P_2O_5	H_2O+	H_2O-	SO_3	Total	Ign. loss	SO_3 fixed	SO_3 volatile
A	0·35	11·70	0·30	36·20	98·65	41·05	7·20	29
B	0·80	14·00	nil	37·80	101·75	41·40	10·90	26·90
C	0·43	12·35	nil	37·40	100·08	40·60	9·15	28·25

The SO_3 fixed was determined, the volatile calculated.

E. J. & A. S.

Van Loan (P. R.) & Nuffield (E. W.). *An X-ray study of roemerite.* Canad. Min., 1959, **6**, 348–356, 3 figs., 8 tables.

Small clove-brown crystals of römerite from Island Mountain, Trinity County, California, have α 1·520, γ 1·578, and axial elements close to those observed by Wolfe [M.A. **7**–165]. Precession photographs yielded a 6·48, b 15·26, c 6·27Å, α 90°04′, β 100°48′, γ 85°28′, the setting agreeing with Wolfe's. Considering the morphology, the space group is deduced as $P\bar{1}$ [incorrectly given in the authors' abstract as $P1$]. Powder data (not indexed) are given. These cell dimensions with a previously determined density of 2·18 and six earlier chemical analyses yield an ideal cell content of 1 [$Fe^{2+}Fe_2^{3+}(SO_4)_4.14H_2O$]. Two tables are given to help in re-orientating a triclinic cell into the 'conventional' setting ($c<a<b$, α and β obtuse).

R. B. F.

Hamilton (P.-K.) [1922–1959] & Kerr (P. F.). *Umohoite from Cameron, Arizona.* Amer. Min., 1959, **44**, 1248–1260, 3 figs., 3 tables.

Umohoite, a hydrous uranium-molybdate has been identified from Cameron, Arizona, U.S.A. Changes in lattice dimensions under X-rays can be stabilized by treatment with ethylene glycol, in a state corresponding to maximum hydration. Consecutive X-ray reflections from three structural modes are evident, with two modes increasing in X-ray reflection intensity and the other decreasing on treatment with ethylene glycol. X-ray diffraction data for the Cameron samples are compared with those of specimens from Marysvale, Utah, U.S.A., and with one from the U.S.S.R. B. H. B.

NEW MINERALS

Volborth (A.). *Gediegen Wismutantimon und andere Erzmineralien im Li-Be-Pegmatit von Viitaniemi, Eräjärvi, Zentralfinnland.* Neues Jahrb. Min., Abhandl., 1960, **94**, 140–149, 2 pls.

The mineragraphic study of a new mineral variety, a native bismuthian antimony with 85% Sb and 15% Bi, is reported. It is regarded as a native SbBi alloy and has properties similar to native Sb, but shows no twinning. It occurs in the hydrothermal portion of the complex Li-Be pegmatite of Viitaniemi, Eräjärvi, central Finland [M.A. **12**–568]. From the same source are described a bismuthian stibiconite (X-ray powder data tabulated), native bismuth, löllingite, arsenopyrite, pyrite, and blende, for all of which qualitative spectrographic results are given, together with senarmontite, and kermesite. R. A. H.

Vorma (Atso). *Laitakarite a new Bi-Se-mineral.* Bull. Comm. géol. Finlande, 1960, **188**, 1–10.

A new Bi-Se mineral discovered at the Orijärvi mine, S.W. Finland, is described. The chemical composition is Bi_4Se_2S. It is isostructural with joséite; the crystal symmetry class is D_{3d}–3_m; space group $R\bar{3}m$, $R32$, or $R3m$. Hexagonal cell dimensions are a 4·225, c 39·93Å; a_{rh} 13·53Å, α 17°58′. *Laitakarite* occurs in quartz-anthophyllite-cordierite-biotite rocks as 0·1–2·0 mm thick veinlets which contain 91·3% laitakarite intergrown with 4·6% chalcopyrite, 2% Bi, chalcopyrite, blende, molybdenite, Ag (Bi-bearing), pyrite, and galena. Sp. gr. of impure material is 7·93±0·08, corrected for impurities, 8·12. Chemical analysis gave Bi 78·28, Pb 0·78, Ag 0·71, Cu 0·26, Zn 0·14, Se 15·50, S 3·28, insol. 0·93, =99·88. V. M.

Knorring (O. von) & Cox (K. G.). *Kennedyite, a new mineral of the pseudobrookite series.* Min. Mag., 1961, **32**, 676–682, 2 figs.

The new mineral *kennedyite* is found in an olivine-augite-alkali feldspar-apatite intrusive rock of the Karroo volcanic succession in the Mateke Hills area of south-eastern Southern Rhodesia. It occurs in tabular or acicular opaque crystals (translucent and dark brown in thin laths), and has a brilliant metallic lustre, sp. gr. 4·07; a 9·77, b 9·95, c 3·73. Indexed X-ray powder data are tabulated; strongest reflections occur at 3·485, 4·88, 2·743, and 1·865Å. Chemical analysis, by O. von Knorring, gave TiO_2 60·33, Al_2O_3 2·15, Fe_2O_3 28·77, Cr_2O_3 0·37, FeO 2·00, MnO 0·07, MgO 6·45, CaO tr., =100·14, leading to the approximate composition $Fe_2MgTi_3O_{10}$ which may be considered to be derived from the isostructural pseudobrookite, $Fe_4Ti_2O_{10}$, by the substitution $FeFe \rightleftharpoons MgTi$. An analysis is also given for the kennedyite-bearing rock, containing 3 to 4% of the mineral. The name is in honour of Professor W. Q. Kennedy.

Kennedyite is thus intermediate in the series Fe_2TiO_5–$MgTi_2O_5$: for the un-named end-member $MgTi_2O_5$ the name *karrooite* is proposed. R. A. H.

Frenzel (Gerhard). *Ein neues Mineral : Freudenbergit* ($Na_2Fe_2Ti_7O_{18}$). Neues Jahrb. Min., Monatshefte, 1961, 12–22, 4 figs.

Freudenbergite occurs as an accessory mineral in an alkaline syenite rich in apatite from the Katzenbuckel (Odenwald). It is hexagonal, a 9·62, c 22·40Å, $Z=6$; sp. gr. 4·3; cleavage (0001) and prismatic. The crystals are black, and in thin section ω deep brown $>\varepsilon$ light brown; optically uniaxial positive with (for Li light) $\omega \approx 2{\cdot}37$, $\epsilon \approx 2{\cdot}42$. Chemical analyses indicate a composition $Na_2Fe_2Ti_7O_{18}$ with some Nb substituting for Ti and with small amounts of Mg, Mn, and K also present. Indexed X-ray powder data are tabulated: reflection in air: R_ω 16·5%, R_ϵ 17·2%. R. A. H.

Roy (D. M.), Gard (J. A.), Nicol (A. W.), & Taylor (H. F. W.). *New data for the calcium silicate, 'phase Z'*. Nature, 1960, **188**, 1187–1188.

'*Phase Z*' prepared hydrothermally at 715°C and 1100 bars was anhydrous with composition $Ca_3Si_2O_7$; when prepared at 200°C and low pressure, it is probably hydrated and with a greater Ca : Si ratio. It is probably always metastable. It is (pseudo-)orthorhombic, body-centred, with a 5·07, b 11·3, c 23Å approximately. The crystals are flaky with (001) cleavage. At 1090°C, it is converted to rankinite. Further details will be published later. [See following abstract] M. J. Le B.

Agrell (S. O.) & Gay (P.). *Kilchoanite, a polymorph of rankinite*. Nature, 1961, **189**, 743.

Preliminary data are given for *kilchoanite* found near Kilchoan, Ardnamurchan, and at Carlingford, previously described as 'phase Z' [see preceding abstract]. It occurs as a replacement of rankinite. Chemical analysis recalculated gives $(Ca_{2\cdot3\cdot47}Mn_{0\cdot03}Fe^{3+}_{0\cdot05})(Si_{1\cdot5\cdot71}Al_{0\cdot35})(O_{5\cdot5\cdot53}OH_{0\cdot47})$ which agrees closely with $8(Ca_3Si_2O_7)$. It is orthorhombic, colourless, α 1·647, γ 1·650, $2V_\gamma$ 60°, $r>v$, D 2·992 g/cc, with probable space group *Imam* or *Ima*2; a 11·42, b 5·09, c 21·95Å, all $\pm$0·05Å. M. J. Le B.

Smith (William Lee), Stone (Jerome), Ross (Daphne R.), & Levine (Harry). *Doverite, a possible new yttrium fluocarbonate from Dover, Morris County, New Jersey*. Amer. Min., 1960, **45**, 92–98, 4 tables.

Doverite occurs in the Scrub Oaks iron mine as brownish red aggregates mixed with xenotime, hematite, and quartz and is mostly rimmed by bastnäsite. The aggregate has H. 6·5, sp. gr. 3·89–4·1+, is moderately radioactive with eU_2O_3 0·5–0·6%; it is anisotropic with refr. ind. in the range 1·700–1·685, extreme minuteness of the individual grains making precision impossible. The composition computed after deduction of admixed material is Y_2O_3(&c.) 34·8, Ce_2O_3 12·1, CaO 23·7, CO_2 24·1, F 5·3, =100·0, with general formula $YFCO_3.CaCO_3$. X-ray powder data are listed. The powder pattern is markedly similar to that of synchisite, and the mineral is probably pseudo-orthorhombic with a 4·07, b 7·06, c 9·12Å. The status of doverite as a new mineral is tentative; it may be an yttrium-bearing synchisite. J. Ph.

[Semenov (E. I.), Ven-Sin (Khun), & Kapitonova (T. A.)] Семенов (Е. И.), Вен-Син (Хун) и Капитонова (Т. А.). О новом ниобиевом минерале Баотите [*Baotite, a new niobium mineral*]. Доклады Акад. Наук СССР [C.R. Acad. Sci. U.S.S.R.], 1961, **136**, 915–916.

Baotite was found in quartz veins near the town of Baotou' Inner Mongolia, and is brownish green in colour, optically positive with ω 1·94, ε 2·16; pleochroism ε greenish brown, ω greenish yellow, $\varepsilon > \omega$; sp. gr. 4·42. It is tetragonal with a 19·68, c 5·88Å; space group $I4_1/a$; $Z=4$; strongest X-ray powder reflections 1·337 (10), 3·55 (8), 2·88 (8), 2·24 (8)Å. Chemical analysis, by A. V. Bykova, gave SiO_2 13·20, TiO_2 33·65, Nb_2O_5 10·80, Al_2O_3 tr., Fe_2O_3 1·75, BaO 38·60, Cl 2·17 (less 0=Cl 0·50), =99·67, leading to the formula $Ba_4Ti_7NbSi_4O_{28}Cl$: spectrographic analysis indicated trace amounts of Sr, Mn, V, Cu, Pb, Sn, and Cr. The structure contains quadruple metasilicate rings of Si_4O_{12} and chains of Ti-Nb octahedra : the chlorine ions are present in large gaps in the structure. The role of chlorine is in the replacement $Nb^{5+}Cl^- \rightarrow Ti^{4+}$, cf. bafertisite [A.M. **45**–754, 1317]. The baotite occurs in quartz veins together with small quantities of albite, alkali amphiboles, aegirine, galena, and pyrite. These hydrothermal quartz veins are found in quartzite near alkali granosyenites. R. A. H.

Kemb (W. Barclay) & Oke (William C.). *Paulingite, a new zeolite, in association with erionite and filiform pyrite*. Amer. Min., 1960, **45**, 79–91, 5 figs.

Paulingite, named in honour of Linus Carl Pauling, was found near Wenatchee, Washington. Semi-quantitative analysis gave H_2O+ 22%; and SiO_2 67, Al_2O_3 9, CaO 7, BaO 2, Na_2O 1, K_2O 10, MgO 0·01% of the dry weight. The mineral occurs as perfect, clean, rhombic dodecahedra, 0·1–1·0 mm diam.; n 1·473 in Na light; a 35·10$\pm$0·02Å; space group probably O^9_h–$Im3m$. Erionite, hexagonal, $D_{6h}{}^4$, $C_{6r}{}^4$, or $D_{3h}{}^4$, with a 13·27, c 15·05Å occurs with paulingite as acicular hexagonal prisms and tufts of very fine fibres. A. C. H.

Milton (Charles), Chao (E. C. T.), Axelrod (Joseph M.), & Grimaldi (Frank S.). *Reedmergnerite, $NaBSi_3O_8$, the boron analogue of albite, from the Green River Formation, Utah.* Amer. Min., 1960, **45**, 188–199, 8 figs.

Reedmergnerite, $NaBSi_3O_8$, is named in honour of Fred S. Reed and John L. Mergner. The crystals, found in unmetamorphosed dolomitic oil shales, are colourless, biaxial, $2V_\alpha$ 80°, refr. ind. α 1·554, β 1·565, γ 1·573, sp. gr. 2·69. Crystals are triclinic, untwinned, elongated along [1$\bar{1}$0] with common forms *a* {100}, *b* {010}, *c* {001}, *m* {110}, *o* {$\bar{1}\bar{1}$1}, θ {$\bar{1}\bar{1}$2}. Space group is $C\bar{1}$, the unit cell has *a* 7·85, *b* 12·38, *c* 6·81, α 93°27′, β 116°23′, γ 91°57′, $Z = 4$, D (calc.) 2·77 gm/cc ; isostructural with albite. An indexed X-ray powder pattern is given. A. C. H.

Paclt (J.). *On a new subfossil liptobiolite from the plain of Sharon in Israel.* Israel Expl. Journ., 1953, **3**, 242–245, 1 pl.

A new species of liptobiolite found in kurkar (calcareous aeolianite rock) is described and named *jaffaite*. It is a gum resin of the resene-resins series. The botanical source is believed to be a member of the genus Pistacia.

D. H. Y.

PHYSICAL PROPERTIES OF MINERALS

Mookherjee (Asoke) & Sahu (K. C.). *Microhardness of the plagioclase series.* Amer. Min., 1960, **45**, 742–744, 1 fig.

Results obtained by the Leitz 'Durimet' microhardness tester showed that in the plagioclase feldspars the trend of variation in hardness conforms with the trends of variation in composition and in structure. A. C. H.

Cuypers (R.) & Amelinckx (S.). *Annealing of X-ray induced surface hardening in NaCl.* Acta Metallurgica, 1960, **8**, 551–553, 5 figs.

In halite crystals surface hardening produced by X-ray irradiation and resoftening due to annealing at different temperatures was observed. The activation energy of the annealing process was derived for the temperature range 150°–300°C. It was assumed, in agreement with other workers, that clusters of point defects are the principal cause of surface hardening. Below 300°C the resoftening resulted mainly from the growth in size of these aggregates, and their corresponding decrease in number.

R. G. Wls.

[Povarennykh (A. S.)] Поваренных (А. С.). О соотношении между твердостью и температурой плавления минералов [*On the relationship between hardness and melting temperature of minerals*]. Мин. Сборник Львовского Геол. Общ. [Min. Mag. Lvov Geol. Soc.], 1958, **12**, 418–423, (English summary).

It is suggested that the degree of bond-covalency is an important factor in determining the hardness and the melting point of minerals. Increase of covalency tends to increase the hardness and to lower the melting point. Thus, the essentially ionic soft fluorite and periclase have almost as high melting points as the highly covalent quartz.

N. R.

Reddy (P. J.) & Subrahmanyam (S. V.). *Thermo-elastic behaviour of calcite.* Acta Cryst., 1960, **13**, 493–494, 2 figs.

The elastic moduli of calcite have been determined at temperatures between 0° and 300°C using a composite piezo-electric oscillator method. The elastic moduli increase linearly with temperature, with a sudden change in gradient at 200°C. J. Z.

Balakrishna (S.). *Ultrasonic velocities in some metamorphic rocks.* Journ. Geol. Soc. India, 1960, **1**, 136–143, 2 figs.

Longitudinal and torsional sound velocities of some metamorphic rocks have been determined employing the ultrasonic pulse method which makes use of the phenomenon of total internal reflection. The effect of granular structure on the transmission of sound and the effect of temperature on sound velocities in metamorphic rocks in the range 3°–110°C have been investigated. Correlation of the sound velocities with the petrogenetic history of the rocks has been attempted. A. P. S.

Balakrishna (S.). *Effect of granular texture on ultrasonic velocities in some rocks.* Indian Min., 1960, **1**, 57–59.

The effect of particle size on ultrasonic velocities in rocks has been investigated. Velocities were found to be low in coarse-grained rocks, and high in fine-grained rocks.

A. P. S.

Kaarsberg (E. A.). *Introductory studies of natural and artificial argillaceous aggregates by sound-propagation and X-ray diffraction methods.* Journ. Geol., 1959, **67**, 447–472.

Differences of sound velocities parallel and perpendicular to the bedding of samples of natural shales may be explained by the preferred orientation of clay particles, which increases

during compaction. Differences of velocities in prepared samples of reference illite and kaolinite are related to differences in fine-structure bonding. Differences of velocities in kaolinite-quartz mixtures cannot be explained on the basis of simple weighted averages of the properties of the two components. R. E. W.

[Volarovich (M. P.), Balashov (D. B.), & Stakhovskaya (Z. I.)] Воларович (М.П.), Балашов (Д. Б.) и Стаховская (З. И.). Исследование упругих свойств горных пород при высоких давлениях [*The study of elastic properties of rocks at high pressures*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 137–144, 6 figs.

The velocity of longitudinal waves in and Young's modulus of basalt, syenite, marble, and other rocks, were measured at pressures up to 5000 kg/cm² by means of a special apparatus here described. The results show that the velocity increases 10–12% with an increase of pressure to 500–1000 kg/cm², then remains more or less constant with a further increase of pressure. Young's modulus also shows the greatest rate of increase at low pressures. S. I. T.

[Grigor'ev (D. P.)] Григорьев (Д. П.). Три типа пластических деформаций галенита [*Three types of plastic deformation of galena*]. Мин. Сборник Львовского Геол. Общ. [Min. Mag. Lvov Geol. Soc.], 1958, **12**, 129–143, 13 figs., (English summary).

A reasoned account is given of the types of plastic deformation of galena as they are found in nature. These types are due to (1) gliding, (2) twinning, and (3) 'polyhedronization'. The last type is produced by the dislocation of separate 'blocks' of a crystal forming an aggregate 'mosaic' pattern. S. I. T.

McCarthy (K. A.) & Ballard (S. S.). *Thermal conductivity of eight halide crystals in the temperature range 220°K to 390°K.* Journ. Appl. Phys., 1960, **31**, 1410–1412, 2 figs.

The thermal conductivity of KBr, KCl, and NaCl varies inversely with temperature for the lower part of the range, and is nearly independent of temperature for the higher part. The thermal conductivity of CsBr, CsI, and AgCl are nearly independent of temperature over the whole range. The thermal conductivity of BaF_2 and CaF_2 vary more rapidly with temperature than would be anticipated from a T^{-1} relationship; the exact form of the variation could not be established from the data. The method used to make the measurements is described. R. G. Wls.

Kumagai (Naoiti) & Itô (Hidebumi). *Measurement of thermal conductivity of granites at high temperatures from 100°C to 690°C.* Mem. Coll. Sci., Univ. Kyoto, ser. B, 1955, **22**, 263–280, 8 figs., 5 tables.

The thermal conductivity was measured under conditions involving temperature gradients up to more than 60°C/cm for a granite and a pegmatitic granite. Both show abrupt changes in thermal conductivity at about 210°C, the granite at about 573°C also. A. P.

Kumagai (Naoiti) & Hanaoka (Takao). *A note on reflecting power of rocks.* Mem. Coll. Sci., Univ. Kyoto, ser. B, 1956, **23**, 275–283, 1 fig., 4 tables.

A formula is derived for calculating the reflecting power of rocks from their average indices of refraction and the incident angle. Observed values, for Na light, at an incident angle of 45° for granite and basalt are 5·9 and 4·1 respectively, calculated values are 5·54 and 4·46. A. P.

Medlin (W. L.). *Thermoluminescent properties of calcite.* Journ. Chem. Phys., 1959, **30**, 451–458, 13 figs.; and, 1960, **32**, 943, 1 fig.

Thermoluminescent peaks in synthetic and natural calcite at 350° and 470°K are activated by Mn^{2+}, with a maximum efficiency at 0·003 mole fraction. Pb^{2+} produces 2 peaks of lower intensity at 300° and 410°K; coactivation by Co^{2+} or Ni^{2+} in the presence of Mn^{2+} gives the 600°K peak generally found in natural samples. Fe^{3+}, Co^{2+}, and Ni^{2+} quench the Mn^{2+} and Pb^{2+} peaks. W. T. H.

Bohun (A.). *The effect of annealing on thermostimulated processes of coloured NaCl crystals.* Czechosl. Journ. Phys., 1960, **B10**, 360–365, (English with Russian summary).

It is shown experimentally that after annealing samples of NaCl not only does the thermoluminescence in the high-temperature maxima increase, which is in agreement with the results of other authors, but also that simultaneously the thermoemission decreases. This effect is probably caused by the formation of a surface layer, which takes place during the evaporation of the sodium and which hinders or prevents rise of the electrons from the crystal, while at the same time the vacancies left in the crystal by loss of sodium increase the concentration of V centres and thus the probability of luminescence. [Author's summary] J. N.

Coufová (P.) & Arend (H.). *On the relation between the thickness dependence of optical absorption and the surface layers of barium titanate single crystals.* Czechosl. Journ. Phys., 1960, **B10**, 663–669, (English with Russian summary).

Single multidomain crystals of $BaTiO_3$, prepared by crystallization in the system $BaCl_2$–BaO–$BaTiO_3$ show optical absorption coefficients in the spectral range 0·43 to 0·7μ which are dependent upon sample thickness. The inter-relation between thickness and absorption coefficient can be explained by the existence of a surface layer which has optical properties differing from those of the inner part of the crystal. By a successive etching method direct determination of the thickness of this surface layer within the thickness range 0·075 to 0·178 mm was carried out; the value $6{\cdot}0 \pm 0{\cdot}2 \times 10^{-4}$ cm was found. J. N.

Bohun (A.), Kantůrek (J.), Trnka (J.), & Lébl (M.). *Electronic processes and Z centres in NaCl and KCl crystals.* Czechosl. Journ. Phys., 1960, **B10**, 349–359, (English with Russian summary).

The paper gives the experimental results of the 'teamwork' study of coloured 'pure' and Ca-doped NaCl and KCl crystals. The mechanism of the formation of *R* centres by coagulation of *F* centres and of the formation of *Z* centres from *F* centres, cation vacancies and Ca ions is discussed. An alternative model for Z_3 centres is proposed. The possible connections between physical and chemical behaviour are indicated. [Author's abstract] J. N.

La Placa (S.) & Post (B.). *Thermal expansion of ice.* Acta Cryst., 1960, **13**, 503–505, 2 figs.

R. A. H.

King (E. G.). *Low temperature heat capacity and entropy at 298·1°K of analcite.* Journ. Amer. Chem. Soc., 1955, **77**, 2192–2193.

The measured heat capacity values of analcite from 53·42° to 298·16°K are given: $S°_{298{\cdot}16} = 56{\cdot}0 \pm 0{\cdot}6$ cal. per degree mol. The entropy of analcite is thus higher by 24·1 units than that of jadeite and 16·0 units higher than the mean of albite and nepheline. Analysis of the analcite [on natrolite from a cavity in a basalt flow, Table Mountain, Golden, Colorado], by E. H. Oslund, gave SiO_2 56·05, TiO_2 0·01, Al_2O_3 22·36, Fe_2O_3 0·03, MgO 0·02, CaO 0·005, Na_2O 13·44, K_2O 0·10, H_2O+ 8·13, H_2O- 0·01, [=100·15]. R. A. H.

Ukai (Yasuo). *Thermal investigation of mineral by means of dielectric behaviours.* Mem. Coll. Sci., Univ. Kyoto, ser. B, 1955, **22**, 185–198, 6 figs., 2 tables.

Variations in dielectric constant with temperature are reported and correlated with d.t.a. and thermal balance curves for one specimen of lepidocrocite, 2 of goethite, 2 of limonite, and 2 of bog iron ore, for each of which chemical analysis and X-ray powder diffraction pattern are tabulated. Observations on the changes of dielectric behaviour of calcite, aragonite, rhodochrosite, chalybite, and cerussite are correlated with transitions, dissociations, and d.t.a. curves. Similar observations are reported for the metamict minerals samarskite, euxenite, fergusonite, and allanite. In each case abrupt changes in the dielectric constant at a certain temperature are accompanied by peaks on the dielectric loss curves. A. P.

Ukai (Yasuo). *A study on the polarization of epidote.* Mem. Coll. Sci., Univ. Kyoto, ser. B, 1954, **21**, 163–170, 6 figs., 2 tables.

The dielectric properties of an epidote of unstated source and composition, having α 1·7367, γ 1·7653, 2V (−) 75°, have been studied on a number of oriented plates at 100 and 500 kilocycles and at temperatures up to 520°C. A. P.

Pankey (Titus) & Senftle (Frank). *Magnetic susceptibility of natural rutile, anatase, and brookite.* Amer. Min., 1959, **44**, 1307–1309.

The magnetic susceptibility of natural crystals of rutile, anatase, and brookite has been measured at room temperature. These range from 0·19 to 0·36 for anatase, 0·26 to 1·53 for brookite, and 0·83 to 1·07 for rutile, with all figures $\times 10^{-6}$ emu/gram. Synthetic rutile and anatase gave measurements of $(0{\cdot}067 \pm 0{\cdot}0015) \times 10^{-6}$ and $(0{\cdot}040 \pm 0{\cdot}0003) \times 10^{-6}$ emu/g respectively. B. H. B.

Yun (Ill). *Experimental studies on magnetic and crystallographic characters of Fe-bearing manganese oxides.* Mem. Coll. Sci., Univ. Kyoto, ser. B, 1958, **25**, 125–137, 8 figs., 3 tables.

Lattice dimensions are reported for 3 tetragonal members, 100, 84, and 73·3 mol% Mn_3O_4, and 7 cubic members, 60 to 0 mol% Mn_3O_4, of mix-crystals in the series Mn_3O_4–Fe_3O_4. Curie points are reported for all but the pure Mn_3O_4 end-member. They rise continuously with increase in Fe_3O_4. The name jacobsite is applied to any natural mix-crystal in the range 0 to 60 mol% Mn_3O_4. The results of Curie point determinations on 50 natural jacobsites are plotted in a histogram which is rather irregular but shows a marked maximum at 160°C corresponding to 60 mol% Mn_3O_4. Of the lattice constants of six jacobsites ranging from 14 to 47 mol% Mn_3O_4 five lie nicely along the straight line determined from synthetic materials when plotted against mol% Mn_3O_4. A. P.

Mathur (S. C.). *A method of measuring principal magnetic susceptibilities of triclinic crystals.* Proc. Nat. Inst. Sci. India, 1960, **26A**, 581–586.

A new method of measuring magnetic susceptibilities of triclinic crystals having an axis of approximate magnetic symmetry is described. A. P. S.

Stacey (F. D.). *Stress-induced magnetic anisotropy of rocks.* Nature, 1960, **188**, 134–135, 1 fig.

The saturation magnetostriction of rocks can be measured in terms of the stress-induced anisotropy. M. J. Le B.

Smith (D. O.). *Magnetization of a magnetite crystal near the Curie point.* Phys. Review, 1956, **102**, 959–963, 9 figs.

Isothermal *M-H* curves for magnetite in the principal crystallographic directions were measured from room temperature to the Curie point. Near the Curie point the magnetizing field required to create a single domain was found to be less than 100 amp/m., giving an unambiguous measure of the spontaneous magnetization in this region. The Curie point was defined to within 0·05°C. Data from the *H-T* curves at constant magnetization showed that the magnetic energy in the region of the Curie point can be expressed as $U_M = \mu_0 W M^2/_2$ where W is a constant.

R. G. Wls.

Mitoff (S. P.). *Electrical conductivity of single crystals of MgO.* Journ. Chem. Phys., 1959, **31**, 1261–1269, 6 figs.; discussion by Hermann Schmalzried, op cit., 1960, **33**, 940, and reply by Mitoff, 941.

The electrical conductivity of synthetic periclase near 1300°C depends on the partial pressure of oxygen, with a minimum at 10^{-5} atm. An extensive theoretical discussion of mechanisms led Mitoff to conclude that conductivity was electronic, and the change with oxygen pressure due to changes in stoichiometry. On the other hand, EMF cell measurements by Schmalzried prove that conductivity must be ionic. The latter results and conclusions are confirmed by Mitoff, leaving the variation of conductivity with oxygen pressure unexplained. W. T. H.

[Parkhomenko (E. I.)] Пархоменко (Э. И.). Пьезоэлектрический эффект горных пород [*Piezoelectric effect of certain rocks*]. Труды пятого сов. эксп. техн. мин. петр. [Trans. fifth conf. exper. techn. min. petr.], Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1958, pp. 248–252, 2 figs.

Various quartz-containing rocks were tested for piezoelectric effect; data for granite samples are given. The piezoelectric modulus depends not only on the quartz content but also on the grain-size and texture of the rocks as well as on the actual size of the test-piece. The possible application of this study to earthquake phenomena is indicated. S. I. T.

Kay (D. A. R.) & Taylor (J.). *Activities of silica in the lime+alumina+silica system.* Trans. Faraday Soc., 1960, **56**, 1372–1386, 12 figs.

Silica activities in the CaO–Al_2O_3–SiO_2 system have been determined at 1450°, 1500°, and 1550°C and the values obtained have been used to derive CaO and Al_2O_3 activities at 1550°C. Free energies of formation from the constituent oxides at 1550°C for mullite, gehlenite, and anorthite are calculated to be −5800, −46000, and −33600 cal. respectively. R. A. H.

Pistorius (Carl W. F. T.) & Sharp (W. E.). *Properties of water. Part VI. Entropy and Gibbs free energy of water in the range* 10–1000°*C and* 1–250,000 *bars.* Amer. Journ. Sci., 1960, **258**, 757–768.

Table 1 gives molar entropy of water in ranges of temperature =10(10)100(20)280°C and for pressures =1,10,50(50)500(100)1400(200)2000,2500 bars, calculated from previously published thermodynamic data. Table 2: molar entropy of water for T =300(20)500(50)1000°C and for P = 1,10(10)100(50)500(100)1400(200)2000,2500 bars. Table 3 gives molar entropy of water for T =10(10)100,160,180°C, and for P =3,3·5,4(1)10(5)25 kilobars. Table 4 gives additional data for T =200(100)500,750,1000°C and P =5(5)30,40,50(50)250 kilobars. Tables 5–8 give (negative) Gibbs molar free energies for ranges corresponding respectively to those listed for tables 1–4, respectively, except that Table 7 contains in addition a column for T =200°C, and a row for 30 kilobars, and Table 8 lacks a column for T =200°. [M.A. **14**–347] H. W.

ROCK-FORMING MINERALS AND PETROLOGY

Rock-forming minerals

Bambauer (H. U.) & Laves (F.). *Zum Adularproblem. I. Adular vom Val Casatscha: Mimetischer Lamellenbau, Variation von Optik and Gitterkonstanten und ihre genetische Deutung.* Schweiz. Min. Petr. Mitt., 1960, **40**, 177–205, 15 figs.

Adularia of Val Casatscha (Medel, Graubünden, Switzerland) proved to consist of domains showing lamellar structure and possessing different phase conditions. In one and the same crystal optical properties were found which, on the one hand, approximate to (high) sanidine optics and, on the other, lie close to microcline optics. Between these extremes a continuous series of intermediate optical orientations was found. It is concluded that the material originally grew as sanidine and later underwent changes tending towards the microcline state. During this process states were realized that can never show stable equilibrium at any temperature. M. W.

Rao (S. V. L. N.). *Carlsbad twinning in potash feldspars.* Quart. Journ. Geol. Min. Met. Soc. India, 1960, **32**, 47–48, 2 figs.

Triple or multiple Carlsbad twins of potash feldspar are described. A. P. S.

Häkli (Aulis). *On high temperature alkali feldspars of some volcanic rocks of Kenya and northern Tanganyika.* Bull. Comm. géol. Finlande, 1960, **188**, 99–108.

The chemical composition, unit-cell dimensions, and optical properties of six high-temperature alkali feldspars from Kenya and northern Tanganyika are given. From the data it is concluded: A distinct difference exists between the feldspar phenocrysts of the phonolites and trachytes; the former are pure alkali feldspars, the latter contain anorthite: (2) the refr. ind. of An-bearing anorthoclases are practically the same as those of plagioclase containing an equal amount of An; this can be explained by the strong effect of Ca on the refr. ind., while Na and K behave nearly identically: (3) the triclinic anorthoclase-sanidine-cryptoperthites are optically 'pseudomonoclinic'; probably because of stress in the crystal lattices, foreshadowing incipient unmixing: (4) the An-component has scarcely any influence upon the *d*-value of the $\bar{2}01$ reflection of the anorthoclases, which is determined almost completely by the Or-content. The groundmass feldspars have become unmixed in both the phonolites and trachytes studied. The albite component of the former has then analcitized, whereas in the latter it has remained unchanged. V. M.

Ferguson (R. B.). *The low-temperature phases of the alkali feldspars and their origin.* Canad. Min., 1960, **6**, 415–436.

Consideration of known alkali feldspar structures leads to the conclusion that the most stable low-temperature forms are not fully ordered with respect to Al-Si but are those forms which have the most favourable electrostatic charge balance. Ionic theory predicts that slowly cooled sanidine will retain monoclinic symmetry and form orthoclase as the stable low temperature phase. An appreciable amount of Na (about 20% $NaAlSi_3O_8$) is required to induce triclinic symmetry in a slowly cooled K-Na feldspar, and an ex-solution origin is proposed for microcline. The degree of triclinicity of microcline depends on the Na content at the time of Al-Si ordering and does not represent a temperature-dependent transition between sanidine and maximum microcline. On the basis of the ionic theory the alkali feldspar phase diagram representing slow cooling of the sanidine–high albite series should show the following low temperature phases: orthoclase, orthoclase+maximum albite, intermediate microcline+intermediate albite, maximum microcline+low albite, low albite. All changes between phases are transitional. Intermediate microcline and intermediate albite may also form as the result of rapid cooling from intermediate temperatures. Evidence for the existence of the K and Na low temperature series and some implications of the theory are discussed. R. J. T.

Smith (J. V.) & MacKenzie (W. S.). *The alkali feldspars V. The nature of orthoclase and microcline perthites and observations concerning the polymorphism of potassium feldspar.* Amer. Min., 1959, **44**, 1169–1186, 13 figs., 1 table.

Thirty-seven orthoclase and microcline perthites, chiefly from pegmatites, have been studied. The potassium phase is monoclinic in 14 specimens, triclinic in 4, and partly each in 15 others. The reciprocal angles α^* and γ^* in the triclinic components vary from 90° and 90° to about 90°24′ and 92°20′ respectively. The exsolved sodium phase is usually low-temperature albite or oligoclase but may be anorthoclase. The optic axial angles, if plotted on an axial angle vs. composition diagram, fall in or close to the triangle bounded by the extremes: low albite (Or_0,$2V_\alpha=100°$), orthoclase (Or_{100},$2V_\alpha=35°$), and maximum microcline (Or_{100},$2V_\alpha=80°$). The albite superstructure is found in the more potassium-rich perthite compositions. Five *b*-axis X-ray oscillation photographs are compared. [M.A. **13**–309] B. H. B.

Emeleus (C. H.) & Smith (J. V.). *The alkali feldspars VI. Sanidine and orthoclase perthites from the Slieve Gullion area, Northern Ireland.* Amer. Min., 1959, **44**, 1187–1209, 12 figs., 4 tables.

Field and mineralogical studies of the porphyritic felsite (one new analysis) and granophyre ring dikes of Slieve Gullion, North Ireland, have been made. A genetic history of the rocks is worked out by correlating field relationships with detailed studies of their sanidine and orthoclase perthite phenocrysts. Textural observations indicate that the majority of the phenocrysts formed slowly at considerable depth. During cooling they changed from homogeneous sanidine to their present perthitic nature through a sequence of unmixing and ordering reactions, the extent of adjustment to low temperature conditions being determined mainly by local content of volatiles and by border freezing. B. H. B.

Kuellmer (Frederick J.). *X-ray intensity measurements on perthitic materials II. Data from natural alkali feldspars.* Journ. Geol., 1960, **68**, 307–323.

Measurements of 79 alkali feldspars from intrusive rocks of western states of U.S.A. show that the $\bar{2}01$ peak-intensities depend on bulk composition and thermal history.

n order of decreasing peak intensities are sanidines, rthoclase perthites, and microcline perthites ; the fact hat these species may occur within the same igneous equence suggests the use of peak intensity data for elineation of temperature zones. [M.A. **14**–148, **15**–97]
R. E. W.

EN (SISIR K.). *Potassium content of natural plagioclases and the origin of antiperthites.* Journ. Geol., **67**, 1959, 479–495.

Seventy-six plagioclases, mainly from amphibolites, ranulites, and volcanic rocks, were analyzed for K and Na by flame photometry and for Ca, Sr, Ba, Fe, and Ti pectrographically. The K-feldspar content was found to epend less on anorthite content than on formation-emperature and availability of K. The antiperthites tudied are believed to have resulted from exsolution during ooling under appropriate conditions ; the K may go to orm sericite under other conditions. R. E. W.

AHAMA (TH. G.). *Kalsilite in the lavas of Mt. Nyiragongo (Belgian Congo).* Journ. Petr., 1960, **1**, 146–171, 7 figs., 2 pls., 2 tables.

Kalsilite occurs as a main constituent in many of the ephelinite lavas of this volcano, either as complex epheline-kalsilite phenocrysts or in the groundmass as rains separate from the nephelines. The author has ıvestigated in detail the genesis of the complex pheno-ysts, and presents X-ray, electron micro-probe and icroscopic data to support his discussion on the history f crystallization of kalsilite in the lavas. Particular ttention is paid to the exsolution textures (liberally lustrated by photomicrographs and diagrams) which form continuous series from phenocrysts with a perthite-like epheline-kalsilite core to those with a homogeneous alsilite core surrounded by a nepheline margin. The initial omposition of the phenocrysts would approximate to $_3NaAl_4Si_4O_{16}$. The existence of separate nepheline and alsilite crystals in the groundmass suggests two-phase ystallization, under certain conditions, in the nepheline-alsilite system. Analyses of a giant leucite aggregate and e attendant groundmass are presented, to illustrate the ccumulation of the former by flotation. G. M. B.

AO (S. V. L. N.). *Co-existence relations in feldspars and their implications.* Indian Min., 1960, **1**, 48–56, 4 figs.

Barth's hypothesis on the coexistence of feldspar pairs examined] and an experimental proof for its validity tlined. The effects of directed pressure and diffusion are ken into consideration and an attempt made to define e phase stability relations of feldspars. A. P. S.

SHARMA (S. R.) & RAJA (N.). *On myrmekite.* Quart. Journ. Geol. Min. Met. Soc. India, 1959, **31**, 127.

Myrmekite is attributed to the breakdown of unstable plagioclases during metamorphism. A. P. S.

RAO (S. V. L. N.). *A note on oligoclase from Sieland, Norway.* Sci. & Culture, 1960, **25**, 541–542.

On the basis of optical study of an oligoclase ($Ab_{78}An_{22}$), it is concluded that the pole of the (010) cleavage moved towards the high temperature curve with a slight increase in 2V, on prolonged heating. The probable presence of a cleavage parallel to the pericline composition plane in oligoclase is suggested. A. P. S.

WIESER (T.). *Pochodzenie budowy pasowej i wtórnych zbliźniaczeń na przykladzie plagioklazów skal magmowych Mrzyglodu* [The origin of zoning and secondary twinning in plagioclase from the igneous rocks of Mrzyglod]. Roczn. Pol. Tow. Geol., 1958, **27**, 25–50.

Many interesting examples of twins and zoning were observed in dyke rocks of dacite and diabase from drill cores at Mrzyglod (northern part of Upper Silesia). Apart from primary and secondary twins, twins developed during the deuteric period of crystallization were observed. The genesis of zoning and twinning is discussed. W. S.

SKRZAT (Z.). *Badania skaleni andezytów pieninskich (w celu wyjaśnienia dwuznaczności przy wyznaczaniu osi bliźniaczej metoda Fiodorowa) oraz wlasnosci optyczne kierunku C* [Investigations of the feldspars of Pieniny (Carpathians) andesites (in order to explain the ambiguity in the determination of the twin axis by Fedorov's method) and the optical properties of direction *c*]. Kwart. Geol., 1959, **3**, 152–159.

In order to avoid errors in direct determination of the twin axis in plagioclase, the author analyses the two already known directions, i.e., the main direction H and second direction C set at right angles to H and to the twin axis B. Both directions H & C show, when aligned with axis A_5 (for H) or axis A_4 (for C) similar optical properties as axis B. Instances of a possible error when the axis B is mistaken for C are quoted. An explanation of the optical properties of direction C is based on Fresnel's equation for the intensity of light passing through crossed nicols and a birefringent plate between them : $I = I_0 \sin 2\phi \sin^2 \pi/\alpha R$. This equation consists of two functions which are obviously so adapted to sections parallel to C of the twin that the intensity of light passing through them is alike. The uniform colour must be ascribed to the physiological properties of the human eye which registers non-identical colours as identical. W. S.

Wenk (E.). *Zur Analyse der Migrationskurven der Hochtemperatur-Plagioklase.* Schweiz. Min. Petr. Mitt., 1960, **40**, 313–322, 4 figs.

It is pointed out that the optical orientation of the high-temperature plagioclases containing 35–100% An changes in such a way that it can be understood as a simple rotation. α, β, and γ of these plagioclases lie on three concentric minor circles in a stereographic diagram. M. W.

Glauser (A.). *Beziehungen zwischen der optischen Orientierung und der hypokubischen Aufstellung natürlicher basischer Plagioklase.* Schweiz. Min. Petr. Mitt., 1960, **40**, 323–345, 6 figs.

It is discussed that α, β, γ, and certain crystallographic faces of basic plagioclase twins often show analogies to cubic symmetry in a stereographic diagram. M. W.

Emmons (R. C.), Crump (R. M.), & Ketner (Keith B.). *High- and low-temperature plagioclase.* Bull. Geol. Soc. America, 1960, **71**, 1417–1420, 2 figs.

The scatter of optical and crystallographic properties of 'low' plagioclase is shown to be broad enough to cover the spread between the migration curves of 'high' and 'low' plagioclase. This scatter militates against the use of plagioclase properties for temperature determinations.

A. L. A.

Tatekawa (Masahisa). *Studies on granitic pegmatites. Quantitative spectrographic determination of magnesium and iron in biotites and other minerals by means of the logarithmic sector.* Mem. Coll. Sci., Univ. Kyoto, ser. B, 1956, **23**, 224–230, 2 figs., 4 tables.

—— —— *Magnesium and iron contents of biotites of small size in granites and pegmatites. Part I.* Op. cit., 1958, **25**, 359–378, 6 figs., 14 tables.

—— —— —— *Part II.* Op. cit., 1959, **26**, 215–238, 7 figs., 8 tables.

A method is described for the rapid quantitative analysis of Mg and Fe in biotites and other minerals in which these elements are present in the range from 4 to 50% Fe_2O_3 and 1 to 17% MgO. A 10 mg. powdered sample is required.

This method is applied to about 80 biotites from granitic rocks mostly of the Tango, Oku-Tango, and Gyoja-Yama districts. Results are discussed in the light of the petrological relations of the biotites.

Observations are extended to the Tanakami-Mikumo granite stock and the pegmatites therein. The results are analysed statistically and the occurrence of allanite correlated with the Fe and Mg content of associated biotites. A. P.

Layton (W.) & Phillips (R.). *The cummingtonite proble* Min. Mag., 1960, **32**, 659–663.

Although the anthophyllites are truly calcium-fr amphiboles, small amounts of calcium are considered to essential to stabilize the monoclinic lattice of cummir tonites, which should be regarded as calcium-poor ampl boles, analogous to the calcium-poor pyroxenes. T existence of synthetic clino-anthophyllite is discusse [M.A. **14**–491] R. A. H.

[Ushakova (E. N.)] Ушакова (Е. Н.). О куммингтонит Завалия на среднем Побужье [*On cummingtonite from t village Zavaliya on the middle Bug*]. Мин. Сборн Львовского Геол. Общ. [Min. Mag. Lvov. Geol. Soc 1958, **12**, 317–322, (English summary).

Cummingtonite occurs in a quartz-hypersthene-garn schist as light yellowish-brown needles ; $c : \gamma$ 19°, 2V 86°–88°, $\gamma-\alpha$ 0·030. Chemical analysis gave SiO_2 51·9 TiO_2 tr., Al_2O_3 1·70, Fe_2O_3 5·15, FeO 29·45, MnO ab MgO 9·25, CaO abs., Na_2O abs., K_2O abs., H_2O- 0·5 ign. loss 2·12, correction on H_2O 0·12, =100·08. X-r data are given. S. I. T.

[Gnativ (G. M.) & Matkovskiĭ (O. I.)] Гнатив (Г. М.) Матковский (О. И.). О биотитах гранитоидов западн Волыни. [*On biotites from granitic rocks of weste Volhynia*]. Мин. Сборник Львовского Геол. Общ. [Mi Mag. Lvov. Geol. Soc.], 1958, **12**, 332–350, (Engli summary).

Biotites from granitic rocks of the north-western pa of the Ukrainian shield are described. Eight chemic analyses are given :

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO
1.	35·34	2·33	16·40	4·80	16·93	0·92	5·95	0·2
2.	35·30	1·50	19·53	5·15	21·30	0·27	5·95	1·0
3.	37·27	2·22	14·15	2·66	18·44	1·03	7·66	0·7
4.	35·02	1·60	21·56	2·20	17·45	0·24	9·15	1·9
5.	33·86	2·32	18·03	1·02	16·77	0·70	12·94	0·9
6.	38·13	—	17·60	2·90	12·52	0·48	15·01	0·7
7.	32·73	1·93	13·49	15·41	23·39	0·84	1·77	—
8.	32·53	0·88	17·90	4·45	30·93	0·49	0·13	0·2

	Na_2O	K_2O	Li_2O	P_2O_5	F	H_2O+	H_2O-	Tots
1.	0·80	8·27	0·13	0·22	0·40	5·35	1·56	99·6
2.	0·81	6·13	—	—	n.det.	2·38	0·42	99·8
3.	1·00	8·23	0·04	0·28	1·54	4·60	0·47	100·3
4.	3·00	5·40	—	—	0·46	2·38	0·30	100·6
5.	3·16	7·44	—	—	n.det.	2·56	0·45	100·1
6.	—	8·20	—	—	n.det.	3·80	0·41	99·7
7.	0·48	8·73	—	—	—	0·75		99·5
8.	0·10	7·19	0·77	—	1·21	3·57	—	100·3

These biotites are representative of three complex distinguished on the basis of the ratio Fe : Fe+Mg. Samp 1 and 2 represent one complex, the Fe : Fe+Mg ratios the biotites are 67·5 and 70·9 mol. %, $n=1{\cdot}652–1{\cdot}66$ another complex is represented by samples 3 to 6, t Fe : Fe+Mg of the biotites ranging from 36·8 to 61 $n<1{\cdot}652$; a third complex by samples 7 and 8, wi Fe : Fe+Mg 92·2 and 99·4 respectively. The diagnos

atio Fe : Fe+Mg of biotites is found to be related to the ame ratio in the rock as a whole. Some qualitative pectrochemical data and limited X-ray data are also rovided. N. R.

ENUGOPAL (J. S.) & SADASHIVAIAH (M. S.). *Iron amphiboles of Hosalli area, Koppal Taluk, Raichur district, Mysore State.* Indian Min., 1960, **1**, 76–85, 1 fig.

Optical data are given on the following amphiboles. Hastingsite : α pale yellow, β yellowish green, γ bluish reen, $2V_\alpha$ 72°, $c : \gamma$ 19°. Common hornblende : α ·631–1·652, yellow, β 1·646–1·665, shade of green, γ ·653–1·676 bluish green, $2V_\alpha$ 62°–78°, $c : \gamma$ 19°–21°. ummingtonite : α 1·635–1·651, β 1·643–1·666, γ 1·659–·683, $2V_\gamma$ 65°–80°, $c : \gamma$ 16°–19°, pleochroic in yellow and ale brown. Grunerite : α 1·663–1·668, β 1·684–1·689, γ ·702–1·709, $2V_\alpha$ 82°–84°, $c : \gamma$ 12°–14°, pleochroic in pale ellow and clove brown. Chemical analyses of a common ornblende, a cummingtonite, and a green grunerite are iven. A gradual transformation from common hornlende to grunerite is envisaged, brought about by recrystalzation during regional metamorphism. A. P. S.

ZOLOTUKHIN (V. V.)] Золотухин (В. В.). К находке оранжевой роговой обманки в андезитах Закарпатья [*The discovery of an orange hornblende in Transcarpathian andesites*]. Мин. Сборник Львовского Геол. Общ. [Min. Mag. Lvov Geol. Soc.], 1958, **12**, 444–448, (English summary).

A very rare mineral pleochroic between brownish orange o yellowish-orange with 2V 79°–82°, $c : \gamma$ 5°–7°, $\gamma-\alpha$ 019, γ 1·711±0·002, α 1·698±0·002 is briefly described nd referred to the group of basaltic hornblendes. The ineral is found as phenocrysts in an olivine-hornblende-yroxene andesite which is described. N. R.

ARMA (S. R.). *Pyroxene in Hyderabad granites.* Quart. Journ. Geol. Min. Met. Soc. India, 1960, **32**, 49, 3 figs.

Pyroxenes in granite are regarded as indicative of 'some ort of basic front'. A. P. S.

AIDU (P. R. J.). *Optic axial angles of pyroxenes of Deccan traps.* Indian Min., 1960, **1**, 68–75.

Based on over 1200 determinations, pigeonite is estimated constitute about 27% of the total pyroxenes in Deccan asalts. This is contrary to West's contention that geonites are rare in Deccan basalts. Many of the geonites are nearly uniaxial which is in consonance with arth's earlier observations. [M.A. **14**–422] A. P. S.

BROWN (G. M.). *The effects of ion substitution on the unit cell dimensions of the common clinopyroxenes.* Amer. Min., 1960, **45**, 15–38, 5 figs.

The unit cell dimensions of eleven analysed augites and ferroaugites from the Skaergaard intrusion and previously published data [M.A. **12**–334, **13**–533] on twelve clinopyroxenes are examined in deriving the variation of the lattice dimensions b and $a \sin\beta$ with ion substitution. The slope of the graph relating b to $Mg^{2+} : Fe^{2+}$ substitution is identical with that for orthorhombic pyroxenes [M.A. **12**, 97]. Substitution of Fe^{2+} for Mg^{2+}, and Fe^{2+} for Ca^{2+} results in a linear increase in b ; Fe^{2+} for Ca^{2+} results in a linear decrease in $a \sin\beta$; Mg for Ca results in a linear decrease in both b and $a \sin\beta$. The three series are combined in a triangular diagram relating unit cell dimensions to $Ca^{2+} : Mg^{2+} : Fe^{2}$ ratio for common clinopyroxenes. The effect of octahedral Al^{3+} is reconsidered. L. G. B.

[SHENDEROVA (A. G.) & SOKOLOVA (E. P.)] Шендерова (А. Г.) и Соколова (Е. П.). Эгирин-диопсид среднего приднепровья ((УССР) [*Aegirine-diopside from the central Dnieper region (Ukrainian S.S.R.)*]. Мин. Сборник Львовского Геол. Общ. [Min. Mag. Lvov Geol. Soc.], 1958, **12**, 306–316, (English summary).

Aegirine-diopside from the ferruginous quartzites interbanded with metasomatic-migmatitic gneisses of Krivoy Rog ore-field is described. The mineral is pleochroic α yellow-greenish, β yellowish, γ greenish, ext. oblique, elongation −ve, $c : \alpha$ 12°–22° rarely >22°, 2V(+) 74°, 80, α 1·700 ±0·005, β 1·710±0·005, γ 1·730±0·005, anomalous rose-violet and indigo-blue in sections $\perp \alpha\beta$, $r > v$. X-ray data are given and comparisons are made with aegirine and diopside. N. R.

KUSHIRO (IKUO). *Si-Al relation in clinopyroxenes from igneous rocks.* Amer. Journ. Sci., 1960, **258**, 548–554.

A total of 140 analyses of clinopyroxenes, recalculated to show amounts of Al and Si in tetrahedral positions in the crystal structures, are plotted on rectangular coordinate diagrams showing Al vs. Si ; Al vs. Ti ; Al vs. Si in certain suites of rocks that represent differentiation products. The diagrams show a close inverse correlation between tetrahedral Al and Si, a much less marked direct correlation between Al and Ti, and several different inverse relations (more properly, 'regressions') between Al and Si in rocks of the Black Jack, Atumi, Stillwater, Skaergaard, and Izu-Hakone districts. Author concludes that the composition of the magma controls the amount of Si in tetrahedral position to a greater extent than temperature during crystallization, and also notes higher Ti in undersaturated alkalic rocks than in saturated ones. H. W.

O'Hara (M. J.). *Co-existing pyroxenes in metamorphic rocks.* Geol. Mag., 1960, **97**, 498–503.

The compositions as deduced from optical data of 18 pyroxene pairs from granulite facies rocks (Madras charnockite series ; Scourie, Scotland, gneisses ; Lappland granulites ; Pennsylvania-Delaware metagabbros) are compared with the chemical analyses. The disagreement is serious for the clinopyroxenes, and it is shown that the tie-lines deduced from the optical data are unreliable. The author disagrees with A. F. Wilson [M.A. **15**–51] that the granulite facies can be subdivided on the basis of tie-line trends, as he finds they do not depart significantly from those of plutonic igneous rocks. On the other hand 8 pyroxene pairs from peridotite nodules in basalts do show a different tie-line trend, the clino-pyroxenes having a higher Fe/Mg ratio than the associated orthopyroxenes. M. G. B.

Seki (Yotaro). *Jadeite in Sanbagawa crystalline schists of central Japan.* Amer. Journ. Sci., 1960, **258**, 705–715.

Pelitic, psammitic, and mafic crystalline schists in the Kantô Mountains and elsewhere in the same metamorphic belt, contain jadeite in association with lawsonite, pumpellyite, epidote, glaucophane, actinolite, chlorite, white mica, plagioclase, and quartz. The optical properties are α 1·650–1·655, β 1·657–1·661, γ 1·667–1·673, $2V_\gamma$ 63°–75°, $r<v$, $c:\gamma$ 39°. Interpretation of the rock composition and mineral association leads to estimates of 200°–300°C and 6–12 kilobars as conditions of formation. H. W.

[Godlevskiĭ (M. N.) & Bataliev (A. D.)] Годлевский (М. Н.) и Баталиев (А. Д.). Фемические минералы дифференцированных трапповых интрузий норильского района [*Femic minerals of the differentiated sills of the Noril region*]. Мин. Сборник Львовского Геол. Общ. [Min. Mag. Lvov Geol. Soc.], 1958, **12**, 196–224, (English summary).

Olivines, pyroxenes, and clinopyroxenes from the differentiated sills are optically described. It is concluded that the Fe content increases and the Ca content decreases upwards. As a result the final stage pyroxenes are Ca-poor. N. R.

Hiss (W. L.) & Hunter (H. E.). *Magnetite-pyroxene textures in basic rocks from the Wichita Mountains.* Oklahoma Geol. Surv., Oklahoma Geol. Notes, 1960, **20**, 254–255, 4 figs.

In the basic layered accumulative rocks in the core of the Wichita Mountain igneous complex magnetite lies interstitially between the silicate minerals ; the clinopyroxenes range from 0·5 to 50 cm in length. In many specimens the magnetite-plagioclase and the pyroxene-plagioclase textural relationships are strikingly similar, suggesting a simil genetic history. Both magnetite and clinopyroxene appe to have crystallized slowly from pore fluid in a plagiocla crystal mush. R. A. H.

Vincent (E. A.). *Ulvöspinel in the Skaergaard intrusio Greenland.* Neues Jahrb. Min., Abhandl., 1960, **9** 993–1016, 4 figs., 6 pls.

Ulvöspinel is the dominant phase first exsolved from t titaniferous magnetite of the Skaergaard primary precipita near the top of the lower olivine gabbros and through t olivine-free middle gabbros. Many of the middle gabbro however, carry magnetite with fine-scale ilmenite lamella and this ilmenite is thought to have been produced at t expense of original ulvöspinel by sub-solvus oxidatio Ulvöspinel is more likely to remain unoxidized in melan cratic band swith 50–60% opaque oxides, and to be oxidize to fine-scale ilmenite in bands with 1–20% opaque oxide In the ferrogabbros some magnetites have broad wel defined ilmenite lamellae due to exsolution at relative high temperatures and later ill-defined, fine-scale lamell of ilmenite due to the late-stage oxidation of ulvöspine There are 13 photomicrographs taken in reflected ligh [M.M. **31**–624 ; M.A. **10**–5, **12**–499] R. A. H.

Chakrabarty (K. L.). *Thermal experiment with t titanium-bearing chromite and vanadium-bearing titan ferous magnetites of Nausahi, (District Keonjhar Orissa.* Sci. & Culture, 1959, **25**, 68–72.

Study, by heating and annealing, of intergrowth texture between chromite-ilmenite, magnetite-ilmenite, an ilmenite-hematite reveal that they are ex-solution inte growths, the ratio of the host and lamellae being constan Chromite-ilmenite is inferred to have formed at 800°–900°C magnetite-ilmenite at 200°–800°C and ilmenite–hematit at 600°–700°C. The hematite lamellae in ilmenite a considered of second generation. A. P. S.

[Lyashkevich (Z. M.)] Ляшкевич (З. М.). О пьедмонтит из Алайского хребта. [*On piedmontite from the Al range*]. Мин. Сборник Львовского Геол. Общ. [Mi Mag. Lvov Geol. Soc.], 1958, **12**, 323–331, 2 figs (English summary).

Piemontite occurs in nepheline syenite as a postmagmat mineral replacing biotite and sericite. In thin section it mostly pink but shows other colours. Refractive indice vary for different colours, α 1·706 to 1·716, γ 1·710 to 1·73 2V 82°–89°. Chemical analysis gave SiO_2 37·93, Al_2O 26·38, Fe_2O_3 5·17, FeO 0·26, Mn_2O_3 3·90, MgO 0·36, Ca 23·15, Na_2O 0·89, K_2O 0·34, H_2O+ 2·08, H_2O- 0·3 = 100·76. X-ray data are given. N. R.

ostyuk (V. P.)] Костюк (В. П.). Минералогическая Характеристика магматического граната в вулканитах закарпатья [*Mineralogical characters of magmatic garnet from volcanic rocks of Transcarpathia*]. Мин. Сборник Львовского Геол. Общ. [Min. Mag. Lvov Geol. Soc.], 1958, **12**, 280–296, (English summary).

Garnets from hypabyssal intrusions and andesites, cites, liparites, and tuffs of western Slovakia are described. ve chemical analyses are given :

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	P_2O_5	H_2O+	H_2O-
39·71	0·35	17·13	4·32	29·32	0·11	1·85	6·14	—	—	0·16
37·87	0·39	18·34	1·60	31·03	1·35	1·84	6·58	0·27	0·67	0·09
34·93	0·32	18·29	4·58	33·93	0·35	1·80	4·82	—	—	—
39·20	0·08	21·03	3·51	22·88	2·82	4·22	5·30	—	—	—
38·20	0·15	21·63	3·22	23·51	2·15	3·90	4·62	—	1·72	—

The first four of these are mineralogically described ving respectively n 1·809±0·004, 1·812, 1·809±0·004, 809, sp. gr. 4·05, 4·10, —, —, a 11·572±0·002Å, 11·573 0·002Å, 11·57±0·00Å, 11·560±0·002Å. Some X-ray ta are suggested as checks of the chemical analyses. ıe analyses of the rocks containing the garnets are esented. N. R.

ostov (I.)] Костов (И.). Генезис дистена из кварцевых исил [*Genesis of kyanite in quartz veins*]. Мин. Сборник Львовского Геол. Общ. [Min. Mag. Lvov Geol. Soc.], 1958, **12**, 262–269, (English summary).

Kyanite-quartz veins from the Jurassic garnet-staurolite ists of western Bulgaria are described. The kyanite urs with the c-axes normal to the vein walls, for which a drothermal origin is suggested. N. R.

helud'ko (T. F.) & Agafonova (T. N.)] Шелудько (Т. Ф.) и Агафонова (Т. Н.). Ставролиты из гнейсов среднего приазовья [*Staurolites from the gneisses of the sub-Azov region*]. Мин. Сборник Львовского Геол. Общ. [Min. Mag. Lvov Geol. Soc.], 1958, **12**, 270–279, (English summary).

Porphyroblastic staurolites in the Precambrian gneisses southern Ukraine are found to have a rhomb-prismatic bit if their (001) and (010) axes lie in the plane of istosity, while if the (001) axes lie in the plane of istosity and the (010) axes are normal to it the common bit is pseudohexagonal. N. R.

da (Tateo) & Korekawa (Masaaki). *On the meta- mictization*. Mem. Coll. Sci., Univ. Kyoto, ser. B, 1954, **21**, 152–162, 4 figs., 2 tables.

X-ray diffractometer patterns reproduced for ten anites indicate that the lattice expands slightly with rease in degree of metamictization. The mechanism of tamictization is discussed and doubt is cast on the sibility of age determination by methods based on gree of metamictization. [M.A. **14**–352] A. P.

Ueda (Tateo) & Korekawa (Masaaki). *Studies on the stability of the radioactive minerals at high temperature*. Mem. Coll. Sci., Univ. Kyoto, ser. B, 1955, **22**, 165–176, 5 figs., 4 tables.

X-ray diffractometer patterns of monazite that has been heated to ca. 1950°C indicate no breakdown of the crystal structure. The structures of zircon, allanite, and gadolinite are destroyed at lower temperatures. A. P.

Ueda (T.). *Studies on the metamictization of radioactive minerals*. Mem. Coll. Sci., Univ. Kyoto, ser. B, 1957, **24**, 81–120, 18 figs., 24 tables.

The X-ray diffraction records of 8 specimens of zircon varying in sp. gr. from 4·66 to 4·18, 12 of allanite with sp. gr. 4·08 to 3·61, 6 of monazite, sp. gr. 5·33 to 5·08 and 2 of xenotime, sp. gr. 4·70 and 4·63, corresponding to various degrees of metamictization, were obtained. Subsequently 2 zircons, 3 allanites, 3 monazites, and one xenotime that had been found to be at least partly metamict were heated to 400°C and to 800°C and their diffractometer patterns after each treatment compared with the patterns of the untreated specimens. Gadolinite from Arendal, Norway, was similarly examined. In addition it was found that melts of monazite and xenotime solidify to their original crystalline phases when quenched at ordinary pressure, while melts of allanite and gadolinite do not. The increase of cell dimensions with degree of metamictization and the contraction upon heat treatment of partly metamict materials are set forth in numerous tables and several graphs. All diffractometer curves are reproduced and indexed powder patterns tabulated for all of the minerals examined. An attempt is made to construct a picture of the mechanism of metamictization. [See preceding abstracts] A. P.

[Kravchenko (G. T.)] Кравченко (Г. Т.). О псевдо- пластинчатости некоторых кристаллов монацита [*On the pseudolamination of some crystals of monazite*]. Мин. Сборник Львовского Геол. Общ. [Min. Mag. Lvov Geol. Soc.], 1958, **12**, 67–70, 5 figs., (English summary).

Certain monazite crystals from a pegmatite in the Ukraine show laminar structure normal to the axis c of the crystal. The laminae appear as dark red-brown and light-coloured stripes of variable width. Under the microscope these laminae can be seen to belong to two sets of polysynthetic twins. S. I. T.

Knorring (O. von) & Clifford (T. N.). *On a skarn monazite occurrence from the Namib desert near Usakos, South-West Africa*. Min. Mag., 1960, **32**, 650–653.

Monazite occurs as large, reddish brown crystals or aggregates embedded in an iron-stained dolomitic marble

approximately 4 miles north 15° west of the Ebony railway stop. Its analysis by O. von Knorring, gave SiO_2 0·13, ThO_2 0·70, Ce_2O_3 33·65, La_2O_3 23·0, Nd_2O_3 10·0, other rare earths 2·18, P_2O_5 30·10, =99·76 ; α 1·787, β 1·789, γ 1·842 ; $2V_\gamma$ 14° ; sp. gr. 5·15. Associated minerals other than dolomite include calcite, magnetite, graphite, and pseudomorphs after earlier skarn silicates. R. A. H.

Iiyama (J. T.). *Recherches sur le rôle de l'eau dans la structure et le polymorphisme de la cordiérite.* Bull. Soc. franç. Min. Crist., 1960, **83**, 155–178, 14 figs., 20 tables.

Crystallographic and chemical studies on cordierites demonstrate the existence of a systematic deficit in oxygen atoms and in the numbers of cations in the structural formula suggested by Bragg [M.A. **4**–354]. It is thus suggested that part of the SiO_4 groups in the structure may be replaced by water in the form $(OH)_4$. The transformation of cordierite from the low-temperature to the high-temperature form [M.A. **12**–615] corresponds to the dehydration of the mineral. The reaction hydrated (low-temperature) cordierite ⟶ anhydrous (high-temperature) cordierite $+ nH_2O$ forms a pseudo-univariant system, dependent on temperature and pressure. The petrological implications are briefly discussed. New chemical analyses are given for 13 cordierites, ranging in Fe/Mg ratio from (A), from a metamorphic area, Laramie Range, Wyoming, U.S.A., to (B), from a pegmatite, Sugama, Fukushima, Japan. Data are also given for the specific gravities, cell parameters, distortion index, loss of weight on heating, and refractive indices for the analysed specimens, and curves are drawn relating $2\theta_{004}$ and the refractive indices of dehydrated cordierite with the $(Fe^{2+}+Mn)/Fe^{+2}+Mn+Mg)$ ratio.

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	H_2O+
A	47·09	0·03	34·86	0·11	2·59	0·05	11·92	0·04	0·78	tr.	1·92
B	44·64	—	29·96	2·72	11·02	1·86	3·08	0·02	2·05	0·75	2·66

	H_2O-	Total	Sp. gr.	α	β	γ	$2V_\alpha$	a(Å)	b(Å)	c(Å)
A	0·65	100·04	2·572	1·534	1·539	1·543	73°	17·095	9·728	9·346
B	0·03	'99·00'	2·732	1·560	1·574	1·578	55°	17·147	9·830	9·301

[M.A. **8**–227, **13**–546] R. A. H.

Shaw (Denis M.). *The geochemistry of scapolite. Part I. Previous work and general mineralogy.* Journ. Petr., 1960, **1**, 218–260.

Earlier work on the mineralogy and petrology of scapolite is reviewed at length. A critical examination of 126 chemical analyses allows only 28 to be considered satisfactory, with 46 classed as dubious and the rest rejected. Six new analyses are given of scapolites from Quebec and Ontario. The chemical data are used to deduce as a general formula $W_4Z_{12}O_{24}.R$, where W is mainly Ca, Na, and K, Z is Si and Al, and R is CO_3, SO_4, $(OH)_2$, Cl_2, or F_2 for meionite, and Cl, F, HCO_3, HSO_4, or OH for marialite. An excess of H is always present, for reasons unknown. A clear answer to the problem of the structural formula cannot be given until the structure has been completely worked out. Refractive index data given with 25 of the satisfactory chemical analyses allowed a satisfactory linear plot of mean refractive index against meionite percentage, but the variation of birefringence was not so simple, nor was that of density. M. G. B.

Shaw (Denis M.). *The geochemistry of scapolite. Part II. Trace elements, petrology, and general geochemistry.* Journ. Petr., 1960, **1**, 261–285.

Experimental details and results of the optical spectrographic analysis of 50 scapolites, mostly Canadian, are given. Major elements Ca, Na, and K, and numerous trace elements were determined. The distribution of the trace elements could be explained by isomorphous substitution, but no detailed correlation of trace elements with each other or with major elements was found. The correlation between refractive index and composition was not so good as in Part I, which is attributed in part to analytical error. Scapolite is characteristically a metamorphic mineral of the upper amphibolite facies or the pyroxene hornfels facies, but it is not restricted to these. From the nature of the elements concentrated in scapolite it is deduced that the mineral develops during metamorphism coupled with the pegmatitic, pneumatolytic, or hydrothermal action of a fluid containing a high concentration of CO_2, Cl_2, and sometimes SO_3. M. G. B.

Kretz (Ralph). *Chemical study of garnet, biotite and hornblende from gneisses of southwestern Quebec, with emphasis on distribution of elements in coexisting minerals.* Journ. Geol., 1959, **67**, 371–402.

A detailed study of the mineral assemblages in a 400 square mile area of Grenville gneiss representing the amphibolite facies shows that in these rocks certain minerals do not exist together and that the compositions of some minerals depend on the presence or absence of certain other minerals in the immediate assemblage. Based on this, a provisional phase diagram is suggested. Spectrographic analyses are given for garnets, biotites, and hornblendes separated from 29 gneiss samples. Fe, Mg, Ti, Mn, V, Cr, Y, and Sc were found to be distributed between these coexisting minerals variously, (1) as a constant ratio, (2) as a regularly changing ratio, (3) according to the amount of another element, or (4) with no apparent regularity. R. E. W.

Saksela (M.). *Beiträge zur Kenntnis der sog. chloritischen Kupferformationen im fennoskandischen Grundgebirge.* Neues Jahrb. Min., Abhandl., 1960, **94**, 319–351, figs., 4 pls.

The 'chloritic copper formations' are intimately related basic igneous rocks, often now metamorphosed. The in ore mineral is chalcopyrite with cubanite lamellae d valleriite, but locally pyrrhotine and pyrite are undant, and cobalt-pentlandite [M.A. **14**–411] also occurs these Karelian copper ores. Descending weathering utions have caused alterations such as : pyrrhotine ⟶ alcocite + marcasite ⟶ covellite. Analyses by E. ndqvist are given for chlorite (A) with yellowish grey to le green pleochroism γ 1·623, $2V_\gamma \approx 10°$; and hornblende) with α (yellowish grey) 1·660, β (grass-green) 1·671, (blue) 1·687, $2V_\gamma \approx 65°$–$70°$, $\gamma : c$ 22°, both from hürfgrube Kyykkä, Kirchspiel Kontiolahti, and for lcite (MnO 0·40%) and an albite-biotite schist.

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O
	25·92	0·01	22·25	1·26	22·32	0·24	17·02	0·00	0·20
	41·32	0·02	11·19	9·34	15·83	0·28	7·94	10·24	1·33

K_2O	P_2O_5	H_2O+	H_2O-	F	less O = F	Total
0·00	0·00	11·30	0·00	0·04	(0·02)	100·54
0·29	—	1·89	0·00	—	—	99·67

R. A. H.

IFFORD (T. N.). *Spessartine and magnesium biotite in coticule-bearing rocks from Mill Hollow, Alstead Township, New Hampshire, U.S.A. A contribution to the petrology of metamorphosed manganiferous sediments.* Neues Jahrb. Min., Abhandl., 1960, **94**, 1369–1400, 3 figs.

Micaceous siliceous schists contain interbedded spessar-ıe-quartz-mica horizons (the coticules), representing iginal manganiferous sediments in less manganiferous ndy argillites which have undergone regional meta-orphism to the sillimanite grade. The spessartine (A), al. E. Padget, makes up more than 5% of the coticules d has n 1·788, D_4^{23} 4·106, a 11·55 ; the co-existing biotite), anal. O. von Knorring, forms about 5% of the coticule rizons and is greenish brown, $2V_\alpha$ 0–5° ; α 1·571, β 1·607, 1·608 ; pleochroism α pale yellow, β, γ dark greenish own. The parent coticule-bearing rock (C), anal. O. von norring, occurs on the south side of the road from Mill ollow to Alstead Center, 410 yards from its intersection th State Highway 123, Mill Hollow, Alstead Township, w Hampshire, U.S.A. Spessartine- and tourmaline-aring muscovite-rich schists stratigraphically underlie ese beds. The tourmaline has ω dark bluish green, pink, and spectrographic analysis (MgO 7·5, FeO 6·2, a_2O 1·8, CaO 0·4, MnO 0·3) shows it to have 50% of the avite molecule ; it is regarded as a metamorphic product boron-bearing sediments. The chemistry of coexisting rnets and biotites in metasediments is discussed ; there pears to be a broad relationship between the Mn^{2+} ntent of the garnet and the Mg^{2+} content of the biotite. [.A. **12**–272, **13**–479]

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO
A	37·58	0·24	20·69	0·97	11·86	23·84	4·04	0·81
B	38·25	1·47	18·28	2·29	7·87	0·49	17·20	0·08
C	56·84	0·54	16·34	2·60	5·68	9·20	3·16	0·76

	BaO	Na_2O	K_2O	Rb_2O	H_2O+	H_2O-	P_2O_5	Total
A	—	—	—	—	—	—	—	100·03
B	0·10	0·39	9·31	0·09	3·73	0·03	—	99·58
C	—	2·75	1·23	—	0·57	0·12	0·04	99·83

R. A. H.

[SHABŸNIN (L. I.)] Шабынин (Л. И.). Еще раз о значении железистости фемических минералов [*Additional note on the value of iron contents in femic minerals*]. Мин. Сборник Львовского Геол. Общ. [Min. Mag. Lvov Geol. Soc.], 1958, **12**, 71–105, 5 figs., (English summary).

Additional data are provided for the correlation of optical properties and the relative amount of iron in phlogopite, biotite, amphiboles, and pyroxenes. S. I. T.

Petrology : Metamorphism—general

FYFE (W. S.), TURNER (F. J.), & VERHOOGEN (J.). *Metamorphic reactions and metamorphic facies.* Mem. Geol. Soc. America, 1958, **73**, 259 pp., 108 figs. Price $4.50.

This book is partly a report of experimental studies and partly theoretical and interpretative. In a sense it supplements the first edition (1951) of Turner and Verhoogen's monumental 'Igneous and Metamorphic Petrology' and it has influenced parts of the second edition (1960). The contents may best be summarized by chapters. Ch. I, 18 pages, entitled 'Concept of metamorphic facies' by F. J. Turner, is in part an historical account. Ch. II, 18 pp., 'General thermodynamic considerations', Fyfe and Verhoogen, includes a discussion of the free energy of metamorphic reactions, effect of temperature on equilibrium, entropy of solids, pressure variable in metamorphism, surface films, and structural aspects of metamorphic minerals. Ch. III, 50 pp., 'Kinetics of metamorphic reactions', Fyfe and Verhoogen, deals with the theory of rate processes, diffusion in solids, polymorphic transformations, reactions between solids, reactions in the presence of water, and hydration and dehydration rates. In this chapter new data are reported on the rate of conversion of kyanite to mullite as a function of temperature, the dehydration of brucite and hydration of periclase, and on the dehydration of boehmite, kaolinite, and chlorite. Ch. IV, 44 pp., 'Equilibrium in systems containing water', Fyfe and Verhoogen, deals with some fundamental properties of water, thermodynamics of hydration reactions, solubility in aqueous systems, the effect of temperature and pressure on the solubility of solids, and with the variation of pH under natural conditions. Ch. V, 28 pp., 'Correlation of metamorphic facies with experimental data', Fyfe and Turner, deals with special features of metamorphic reactions and with physical conditions of formation of individual

metamorphic facies. Ch. VI, 11 pp., 'Water and heat in metamorphism', Fyfe and Verhoogen, deals with the source of water in metamorphism, the temperature distribution, and heat flow. In the final chapter, VII, 41 pp., 'Mineral assemblages of individual metamorphic facies', Turner discusses the recognized facies and presents a *P-T* diagram showing a field for each. The bibliography runs to 11 pages. A. P.

Griggs (David) & Handin (John), editors. *Rock deformation (A Symposium)*. Mem. Geol. Soc. America, 1960, **79**, xi+382 pp. Price $12.00.

A collection of most of the papers presented at a symposium on rock deformation held at the Institute of Geophysics, University of California, Los Angeles, in November, 1956. A brief foreword by M. K. Hubbert is followed by 13 chapters, mostly concerned with experimental work on rock deformation. Ch. 1, 'Orientation of anisotropic minerals in a stress field', pp. 1–8, by Gordon J. F. MacDonald, and Ch. 2, 'Orientation of anisotropic minerals in a stress field : Discussion', by W. F. Brace, pp. 9–20, 5 figs., give the theoretical background. Ch. 3, 'Annealing recrystallization of calcite crystals and aggregates', by D. T. Griggs, M. S. Paterson, H. C. Heard, & F. J. Turner, pp. 21–37, 5 figs., 6 pls., [M.A. **14**–190]. Ch. 4, 'Deformation of rocks at 500° to 800°C', by D. T. Griggs, F. J. Turner & H. C. Heard, pp. 39–104, 30 figs., 12 pls. [M.A. **13**–375]. Ch. 5, 'Experiments on compaction and cementation of sand', by John C. Maxwell, pp. 105–132, 11 figs., 3 pls. Ch. 6, 'Experimental deformation of St. Peter Sand : A study of cataclastic flow', by Iris Borg, Melvin Friedman, John Handin, & Donald V. Higgs, pp. 133–191, 28 figs., 2 pls. Ch. 7, 'Transition from brittle fracture to ductile flow in Solenhofen limestone as a function of temperature, confining pressure, and interstitial fluid pressure', by Hugh C. Heard, pp. 193–226, 15 figs., 3 pls. Ch. 8, 'Creep of Solenhofen limestone under moderate hydrostatic pressure', by Eugene C. Robertson, pp. 227–244, 9 figs. Ch. 9, 'Torsion of Yule marble under confining pressure', by John Handin, Donald V. Higgs, & Joseph K. O'Brien, pp. 245–274, 15 figs., 3 pls. [M.A. **12**–384-5] Ch. 10, 'Petrofabric analysis by means of the X-ray diffractometer', by Donald V. Higgs, M. Friedman, & John E. Gebhart, pp. 275–292, 11 figs., 1 pl. Ch. 11, 'Faulting as a velocity discontinuity in plastic deformation', by Helmer Odé, pp. 293–321, 21 figs. Ch. 12, 'Mechanism of seismic faulting', by E. Orowan, pp. 323–345, 10 figs. Ch. 13, 'Observations on fracture and a hypothesis of earthquakes', by David Griggs & John Handin, pp. 347–364, 2 figs., 10 plates. There is a common bibliography of nearly 250 items, a common author index and a common subject index. A. P.

Barth (T. F. W.). *Principles of classification and norm calculations of metamorphic rocks*. Journ. Geology, 1959, **67**, 135–152.

The 'catanorm' uses the standard minerals of the CIPW norm, expressed in terms of molecular percentages, and applied to high grade metamorphic rocks. The 'meso norm' is designed for rocks of the mesozone, such as the amphibolites, and includes hornblende, actinolite, barkevikite, and biotite as standard minerals, in addition to the feldspars, quartz, and nepheline. The 'epinorm' is designed for rocks of the epizone, of which the greenschist facies is an example, and includes chlorite, zoisite, muscovite, kaolinite, dolomite, and calcite as standard minerals. Several examples are given for calculations of the mesonorm. R. E. W.

Bennington (K. O.). *Energy transfer from differentiation in a differential pressure system under non-equilibrium conditions*. Journ. Geology, 1959, **67**, 171–197.

Continuously changing conditions prevent attainment of equilibrium during metamorphism. In such a system migrating materials set up a thermal gradient and transfer energy of activation. A given reaction is studied by distributing heats of formations of the minerals among their oxide constituents [cf. discussion by Ramberg, *ibid.* 1960, **68**, 110–113, and reply]. That part of the system under endothermic conditions is depleted while the part under exothermic conditions is enriched. R. E. W.

Goldsmith (Richard). *Granofels, a new metamorphic rock name*. Journ. Geol., 1959, **67**, 109–110.

Granofels is proposed as a field name for metamorphic rocks having medium to coarse granoblastic texture. It is transitional with hornfels in grain size and with gneiss in texture. R. E. W.

[Dudykina (A. S.)] Дудыкина (А. С.). Парагенетические ассоциации элементов-примесей в гранатах различного генезиса [*Paragenetic association of trace elements in garnets of various genesis*]. Труды института геологии рудных месторождений, петрографии, минералогии и геохимии. [Trans. Inst. Geol. of Ore-deposits, Petr. Min. & Geochem.], 1959, **28**, 90–110.

This is a statistical work on a large number of garnets from various kinds of igneous and metamorphic rocks. It is found that certain trace elements are associated with garnets belonging to a certain group of garnet-bearing rocks. S. I. T.

Petrology : metamorphism—thermal, etc.

Farrand (M. G.). *The distribution of some elements across the contacts of four xenoliths*. Geol. Mag., 1960, **97**, 488–493.

Determinations of trace elements and Na and K contents were made for the Shap adamellite, the Glen Fyne porphyritic granodiorite, the margins and cores of two basic xenoliths from each of these intrusions, and of the assumed parent rocks of the xenoliths and their contact-altered equivalents. The trace element and alkali contents of 11 samples of potash feldspar and 12 samples of sphene separated from the xenoliths and their host rocks were also determined. The results are discussed in the light of evidence of mineralogical equilibrium between the xenoliths and the surrounding host rocks. B. C. M. B.

Leake (B. E.) & Skirrow (Geoffrey). *The pelitic hornfelses of the Cashel-Lough Wheelaun intrusion, County Galway, Eire.* Journ. Geol., 1960, **68**, 23–40.

Field, microscopic, and chemical study (14 chemical analyses by rapid method of Riley [M.A. **14**–87]) suggest that the material sweated out of pelitic xenoliths into the enclosing ultrabasic magma had a composition similar to that predicted by Bowen, consisting principally of silica, alumina, and alkalis with only minor amounts of other oxides. R. E. W.

Ackermann (P. B.) & Walker (F.). *Vitrification of arkose by Karroo dolerite near Heilbron, Orange Free State.* Quart. Journ. Geol. Soc. London, 1960, **116**, 239–254.

A 50-foot sill of Karroo dolerite near Heilbron, O.F.S., has fused arkose of the overlying Ecca Series to a dark buchite. Progressive vitrification accompanied by mineralogical changes may be traced towards the contact at which hybridism between dolerite and vitrified sediment has taken place locally. The phenomena involved are described with the aid of micrometric data and 10 new chemical analyses. [Authors' abstract] B. C. M. B.

Kardymowicz (I.). *Enklawy w andezytach okolic Pienin* [Inclusions in the andesites of the Pieniny region (Carpathians)]. Biul. Inst. Geol., 1957, **117**, 1–90, 2 figs., 67 tables, (Polish with English and Russian summaries).

Numerous inclusions in the andesites from Czorsztyn, Jarmuta, and Bryjarka near Szczawnica are described. The metamorphic processes to which the inclusions were subjected are discussed. W. S.

Ljunggren (P.). *Petrogenetic significance of gneiss blocks partly melted by hyperite magma.* Fysiograf. Sällsk. Förh. Lund, 1959, **29**, 75–90, 3 figs.

In the hyperite dyke at Hökås in southern Sweden inclusions of gneiss were enclosed in the hyperite magma upon its intrusion into the gneiss complex. These magma-floated blocks suffered partial melting which gave rise to a mineral association quite different from that of the original gneiss. The plagioclase and the microcline of the gneiss recrystallized into large phenocrysts; the microcline changed into orthoclase. The phenocrysts became surrounded by a single-crystal border of plagioclase of myrmekitic development. Biotite and hornblende were obviously unaffected by recrystallization. The groundmass of the original gneisses consisted of microcline, albitic plagioclase, quartz, biotite, hornblende, and accessory minerals. The microcline has perthitic patches of albitic plagioclase and gives an X-ray pattern with $d_{\bar{2}01}$ at 4·23Å indicating a potash feldspar almost free of Ab. The orthoclase in the groundmass of the magma-floated gneiss has perthitic patches of plagioclase with 8–12% An; $d_{\bar{2}01}$ is found at 4·25Å; $2V_{\alpha}$ 60°. The formation of orthoclase and microcline is discussed as is also the problem of myrmekite formation under different conditions. E. W.

Pichamuthu (C. S.). *The significance of clouded plagioclase in the basic dykes of Mysore State, India.* Journ. Geol. Soc. India, 1960, **1**, 68–79, 3 figs., 2 pls.

Clouding of plagioclase feldspars in dykes cutting older charnockites is attributed to regional thermal metamorphism, connected with the formation of later palingenetic charnockites. A. P. S.

Bandyopadhyay (Samir Kumar). *On a burnt coal outcrop, Raniganj coal field.* Quart. Journ. Geol. Min. Met. Soc. India, 1959, **31**, 65–66, 3 figs.

Some fused shales are described as mullite-tridymite-cordierite buchites. A. P. S.

Phillips (E. R.). *An olivine-bearing hornfels from south-eastern Queensland.* Geol. Mag., 1959, **96**, 377–384.

An olivine(Fa_{17})-labradorite-hornblende-hypersthene-clinopyroxene-magnetite-apatite hornfels is described, which occurs at the contact of an argillite with a quartz-gabbro. The argillite is of unusual composition; analyses of it and of the hornfels and the gabbro are given. R. St.J. L.

Compton (Robert R.). *Contact metamorphism in Santa Rosa Range, Nevada.* Bull. Geol. Soc. America, 1960, **71**, 1383–1416, 6 figs., 5 pls.

A 20,000 foot sequence of Upper Triassic (and Jurassic?) folded metasediments is intruded by granitic stocks. The metasediments, of dominantly pelitic composition but including quartzitic, calcareous, and dolomite members were converted to metamorphic assemblages of quartz, albite, muscovite, chlorite, and carbonates before and during the regional folding. The 9 intrusive stocks consist

mainly of sodic granodiorite, but adamellite, trondhjemite, and tonalite are locally abundant. Two chemical analyses are given of the granodiorite. Forty-six chemical analyses, with modal analyses, of metapelites indicate a very small range of composition. Except for dehydration, the only metasomatism during progressive contact metamorphism was minor desilication and addition of Fe around one stock. Along with quartz and muscovite four combinations of critical minerals are developed in the contact metamorphic aureoles — cordierite-biotite, cordierite-andalusite-biotite, staurolite-andalusite-biotite, and andalusite-biotite. Differences in original composition are considered as the possible reason for the four assemblages, but it is concluded that only the cordierite-biotite assemblage can be explained in this way and that kinetic factors were more important. A. L. A.

Nicolas (Jean) & Legrand (Charles). *Sur l'altération des phyllades coblenciens au voisinage de Saint-Mayeux (Côtes du Nord).* C.R. Acad., Sci., Paris, 1958, **246**, 3362–3364.

Near Saint-Mayeux local alteration of dark quartzo-micaceous schists, rich in iron and with chlorite and chloritoid, has caused the formation of a white clay consisting almost wholly of kaolinite and quartz. Quartz is concentrated in the fractions coarser than 10 μ ; kaolinite is dominant in the finer fractions. [Author's summary] E. J. & A. S.

Lovering (T. S.) & Shepard (Anna O.). *Hydrothermal alteration zones caused by halogen acid solutions, East Tintic District, Utah.* Amer. Journ. Sci., 1960, **258-A**, 215–229.

In Homansville Canyon, Utah, a small clay deposit containing fluorite, diaspore, quartz, hematite, and Mn-oxides, occurs at the intersection of a small fissure and the contact of Tertiary quartz latite lava with Cambrian limestone. The fissure was traced 100 yards into an argillized monzonite plug. The zones of alteration are parallel to the lava-dolomite contact. Lava is altered through a 4-ft. zone into montmorillonite and a little kaolinite. Dolomite is replaced by a sequence of zones : hematite + quartz for 5 to 8 feet grading into a zone of the same minerals with Mn oxides, and minor apatite and kaolinite — a fluorite + kaolin + diaspore zone — kaolin + diaspore + fluorite — kaolin + mica — granular dolomite with kaolin and mica. Hard, fresh dolomite extends outward for several hundred feet beyond these. X-ray, mass-spectrographic, and petrographic studies indicate reactions with acid emanations containing halides of Fe, Al, and Si at temperatures up to 300°C, yielding zones that reflect increasing pH caused by wall rock reactions. Nine rock analyses and one for minor and trace elements in pyrolusite are given. H. W.

LaGanza (R. F.). *Paragenetic relationships of deuteric minerals in Triassic dolerite near New Haven, Connecticut.* Neues Jahrb. Min., Abhandl., 1960, **94**, 559–563, 1 fig.

The order of formation of the deuteric minerals in a pillow lava is considered to be : calcite, quartz with hematite and goethite, etching of hematite, calcite with hematite and goethite, and sulphides with hematite and goethite. Crystal cavities appear to have been produced by the coating of anhydrite crystals with chalcedony and the subsequent removal of the anhydrite, as suggested for the zeolite cavities of New Jersey [M.A. **5**–230] : anhydrite is found in the pillow lava itself. R. A. H.

Iwao (Shuichi). *Hydrothermal gypsum deposits of the Wanibuchi mine, Japan, with special reference to alteration of wall rocks.* Japanese Journ. Geol. Geogr., 1956, **27**, 105–132, 10 figs., 2 pls., 13 tables.

A gypsum deposit of shallow hydrothermal replacement origin, situated in marine Tertiary strata that are largely pyroclastic, has been exploited by two mines. The alteration of the rocks surrounding the gypsum deposit is described in detail. An inner Mg-chlorite zone is overlapped by an outer montmorillonite zone. Chemical analyses are reported for two weakly altered dacite tuffs, for a 'black shale' which is really tuffaceous rhyolite (SiO_2 69·14), two altered rocks of the montmorillonite zone (SiO_2 56·50, 30·78), two of the Mg-chlorites (SiO_2 30·75, 35·04) and one of the gypsum mass (SiO_2 11·34). The results of spectrographic tests for 18 minor elements are tabulated. Most abundant among these are Sr, 50 to 1800 p.p.m., and Mn, 100 to 800 p.p.m., both present in all samples recorded. A. P.

Reed (J. J.). *Soda-metasomatised argillites associated with the Nelson ultramafic belt.* New Zealand Journ. Geol. Geophys., 1959, **2**, 905–915, 5 figs.

Petrographic, chemical, and X-ray study of indurated argillites associated with ultramafic rocks [probably upper Palaeozoic] in Nelson province indicates marked soda metasomatism. The hardness of the argillites is due largely to albitization, but additional toughness has been imparted in some specimens by a felted crystallization of minute tremolite fibres. Na_2O content reaches 9·68% in one specimen from Dun Mountain. Brief mineralogical data for the albite and tremolite are given. The hypothesis that the indurated argillites were enclosed and altered by the ultramafic rocks appears the most probable. W. A. W.

Koutek (J.). *Hybridní horniny na magnetovcovém ložisku na Fiolníku u Vlastějovice v Posázaví* [Hybrid rocks from the magnetite deposit on Berg Fiolník near Vlastějovice on the R. Sasau]. Časopis Národního Musea, Prague, 1958, **127**, 1–4. [In Czech]

The paper continues the author's earlier work on skarns rom Vlastějovice on the R. Sasawa in east Bohemia. It eals with 2 bodies of skarn on the Fiolník hill. In both eld and underground mapping interesting hybrid rocks s well as skarn, magnetite-rock, pegmatites, para- and rthogneisses were studied. The hybrid rocks include 1) types arising from reaction of pegmatite on skarn and nagnetite-rock, (2) pseudodiorite arising from reaction etween skarn and the surrounding orthogneiss, (3) hybrids etween orthogneiss and paragneiss. The original types of ock as well as the hybrids are described petrographically nd their genesis explained. V. Š.

Piccoli (G.). *Fenomeni metamorfico-metasomatici nelle rocce verdi di Novate Mezzola con formazione di migmatiti.* Rept. 21st Intern. Geol. Congr. Norden, 1960, Part **13**, 383–393, 1 fig.

The intrusion of the San Fedelino granite into serpentious and amphibolitic rocks and marbles in the Novate Mezzola zone, Province of Sondrio, Italy, has caused considerable metamorphism. Metasomatism has produced eldspar crystals in the micaceous amphibolite ; such feldsathized rocks can be considered as reaction-pegmatites. R. A. H.

Viswanathan (S.). *The contaminated granites of Sankaridrug, Salem district, Madras State.* Indian Min., 1960, **1**, 101–107.

Diopside calc-granulites are described as having contaminated a microcline granite, resulting in the development f hedenbergite-garnet granite, and diopside granite. A. P. S.

Levy (C.) & Prouhet (J.). *Geothermometrie du gisement plombo-zincifère de Sentein (France).* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **16**, 200–208, 3 figs.

A deposit of blende, pyrrhotine, and galena occurs in metamorphosed reef limestone at Sentein, Ariège ; associated minerals include quartz, tremolite, chlorite (pennine), iotite, and anthophyllite(?). The presence of these ilicates is taken to indicate a metasomatic occurrence of ydrothermal origin. A decrease in the iron content of the lende from the base to the top of the deposit indicates a ecrease in temperature [M.A. **12**–387]. Trace element eterminations for blende include quantitative values for In, Ge, Ga, and Sn, and qualitative determinations of Ag and Pb. R. A. H.

Ackermann (K. J.), Nicholson (R.), & Walton (B. J.). *Mineral development and deformation in metasedimentary rocks in the Glomfjord region, northern Norway.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **19**, 54–63, 1 fig.

The folded Lower Palaeozoic rocks of the Glomfjord region include quartzofeldspathic schists and calcareous and pelitic rocks, all forming an envelope to granite, and a calcsilicate marble with minor pelitic horizons. Post-kinematic metasomatism of the marbles gave rise to vesuvianite, grossular, wollastonite, and microcline. In the pelitic rocks of the marble unit the earlier folding gave muscovite ; in the interval between first and second folding kyanite, staurolite, and garnet porphyroblasts grew and during the second deformation rotation of the porphyroblasts occurred. R. A. H.

[Serdyuchenko (D. P.)] Сердюченко (Д. П.). Магнезиоферриты и титаншпинели из кембрийской толщи Алдана [*Magnesioferrites and titanspinels from the Cambrian strata of the Aldan*]. Мин. Сборник Львовского Геол. Общ. [Min. Mag. Lvov Geol. Soc.], 1958, **12**, 233–245, 4 figs., (English summary).

At the place Magnetite in southern Yakutia there is a development of a magnetite-chondrodite rock in Cambrian dolomitized limestone near the contact of an intrusive syenite porphyry. Other contact-metasomatic rocks contain magnesium-spinel, magnetite, and magnesium orthotitanite (Mg_2TiO_4). Several analyses of rocks and minerals are given. S. I. T.

Rao (Leelananda N.). *Contaminated basic members of charnockite series of Pallawaram, Madras, India.* Indian Min., 1960, **1**, 60–61, 5 figs.

Garnetiferous diopside granulites, and related calc-scapolite diopside granulites are considered products of contamination of basic charnockites (augite norites) by lime-silicate-rich rocks found as xenoliths. [The magnetite % in norm of rock 2 is incorrect, and also the identification of a garnet (p. 65) from refr. ind.] A. P. S.

Das (Dilip Kumar). *On the scapolitization of feldspar from area around Angul, Orissa.* Quart. Journ. Geol. Min. Met. Soc. India, 1959, **31**, 61–62.

Describes scapolite, ω 1·595, ε 1·555, attributing its formation to alteration of plagioclase consequent on acid intrusion. A. P. S.

White (A. J. R.). *Scapolite-bearing marbles and calc-silicate rocks from Tungkillo and Milandella, South Australia.* Geol. Mag., 1959, **96**, 285–306.

A regional development of scapolite-marbles associated with amphibolite facies rocks is described from an area 40 miles east of Adelaide. Scapolite marbles are distributed throughout many hundreds of square miles. Primary

assemblages include clinopyroxene-scapolite-sphene-quartz-microcline, hornblende-scapolite-quartz-microcline-biotite-sphene-tourmaline-magnetite, and plagioclase-scapolite-bearing assemblages with An_{50} or An_{60}. Analyses of a clinopyroxene ($Ca_{49}Mg_{27}Fe_{24}$) and a scapolite ($Ma_{43\cdot7}Me_{56\cdot3}$) with optical data are given; also analyses of co-existing andradite ($Gr_{14\cdot84}Andr_{79\cdot74}Alm_{3\cdot64}Sp_{1\cdot78}Pyr_{tr}$) and grossular ($Gr_{56\cdot42}Andr_{24\cdot07}Alm_{14\cdot30}Sp_{5\cdot21}Pyr_{nil}$) with optical, density, and X-ray data. From textural evidence, actinolite, epidote, grossular and andradite in the marbles have been formed by a later metasomatism. The source of the chlorine for scapolite formation is thought to be in the original calcareous shales. R. St J. L.

Burke (Kevin). *Replacement veins in the Dahomeyan of Ghana.* Geol. Mag., 1959, **96**, 353–360.

Basic scapolite gneisses contain cross-cutting acid scapolite-bearing veins which form 10% of the rock over great areas. Textural evidence indicates replacement. R. St J. L.

Sutton (John) & Watson (Janet). *Metamorphism in deep-seated zones of transcurrent movement at Kungwe Bay, Tanganyika Territory.* Journ. Geol., 1959, **67**, 1–13.

Whereas the mineral assemblage in the broad shear belts is of lower grade than that of the country rock, that of the mylonite belts is generally similar in grade to that of its country rock, despite large differences in texture and in proportions of minerals. The high grade of metamorphic minerals developed and preserved in some mylonite belts is ascribed to energy released as heat during deep-seated transcurrent faulting. Such rocks may represent examples of the mode of crustal deformation at depth today along some of the active seismic zones. R. E. W.

Bryn (Knut Ørn). *Et funn av pseudotachylitt i S. Trøndelag, og en teori for dannelsen,* (English summary). Norges Geol. Unders., 1960, **211**, 8–17, 5 figs.

The pseudotachylite forms thin dark veins cutting across the schistosity of a micaschist belonging to the Norwegian Caledonides. It contains xenoliths of the country rock. Chemical analysis shows that it is considerably more basic than the country rock. It is suggested that the pseudotachylite is due to the formation of hot spots during relatively local dislocations. [See following abstract] I. W. O.

Reitan (Paul H.). *Refleksjoner over betydningen av høye punkt-temperaturer på overflater i forbindelse med bevegelser i bergarter.* Norges Geol. Unders., 1960, **211**, 98–104 1 fig., (English abstract).

The possibility of formation of hot spots [Bowden and Thomas, 1954, Proc. Roy. Soc. London, ser. A, **223**, 29–39] in rocks during tectonic movements is considered, and the possible changes caused thereby are discussed. One suggestion is that hot spots may be capable of stimulating the recrystallization of metastable phases in shear zones so that these may exhibit other mineral facies than their surroundings. I. W. O.

Petrology : metamorphism—regional

Battey (M. H.). *Observations on the peridotites and pyroxenites of the Jotunheim complex in Norway.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part 13, 198–207, 2 figs.

Dunite and pyroxenite bodies occurring in feldspathic two-pyroxene gneisses (Jotun-norites) between Glittertind and Galdhöpiggen appear to be isolated sheets and lenses. They are generally concordant with the foliation of the surrounding gneisses but show transgressive features in detail. In the ultramafic rocks there is little mineralogical variation, with olivine β 1·691–1·695, $2V_\alpha \approx 87°$, orthopyroxene γ 1·689–1·692, $2V_\alpha \approx 81°$, and clinopyroxene 1·684–1·687, $2V_\gamma$ 54–59° : occasional cummingtonite occurs near the margins, with α 1·649, β 1·656, γ 1·670, $2V_\gamma$ 85–87°, $\gamma : c$ 19°. The pyroxenes in the granulites adjacent to the ultramafics are slightly more iron-rich. At the contact between the ultramafic and pyroxene-feldspar rocks there is a zone of diablastic intergrowth of green hornblende and plagioclase with minor ceylonite. R. A. H.

Randall (B. A. O.). *Sagvandites of Lyngen, Troms, north Norway.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **13**, 443–451, 4 figs.

Five bodies of sagvandite occur within Caledonoid rocks near Lyngen Fjord; they differ from the type rock (90% enstatite, 10% magnesite) from Sagvandet, 15 km south-west of Lyngen, in having dolomite in place of magnesite and in containing a small amount of olivine. Contact varieties may contain chlorite, phlogopite, and green spinel, but away from the contact the sagvandite consists essentially of enstatite (γ 1·672, En_{94}), olivine, and dolomite, the dolomite amounting to 5–40% and the olivine forming up to 30% of the rock; occasional radial crystals of enstatite may be 12 cm in length. The rock succession is made up of alternations of dolomite marble and kyanite-garnet-mica schist. This association of marble and high grade metamorphism is common to most known sagvandites. It is suggested that the Lyngen sagvandite was formed by metasomatism of limestone, but other modes of origin are discussed. [M.A. **3**–291, **4**–286] R. A. H.

Peltola (Esko). *On the black schists in the Outokumpu region in eastern Finland.* Bull. Comm. géol. Finlande 1960, **192**, 1–107, 43 figs., 11 tables, 8 pls., 2 maps.

The mode of occurrence, petrography, mineralogy, and chemical composition of the black schists (graphite- and sulphide-bearing schists) of the Outokumpu region of eastern Finland are described. Three principal types, argillaceous, calcareous, and arenaceous black schists are distinguished on the basis of origin, and their petrography and metamorphism are elucidated. Special attention is paid to the opaque minerals and to the chemistry which is illustrated by many chemical analyses. M. H.

Edelman (Nils). *The Gullkrona region, SW Finland.* Bull. Comm. géol. Finlande, 1960, **187**, 1–87, 44 figs.

The region studied belongs to the archipelago of SW Finland where the Svecofennidic rocks are strongly deformed and highly recrystallized. The most common rocks are migmatitic granites. Four principal types and stages of migmatites are distinguished. The metamorphic evolution of the ultrabasic rocks has been long and complicated. The structure of the region is characterized by large domes of migmatitic granites and basins of gneisses and amphibolites. Large granite domes are often composed of minor domes separated by synclines of gneisses.

M. H.

O'Hara (M. J.). *A garnet-hornblende-pyroxene rock from Glenelg, Inverness-shire.* Geol. Mag., 1960, **97**, 145–156.

Analyses and optical data, etc., are given for a green clinopyroxene ($Wo_{46}En_{41\cdot5}Fs_{12\cdot5}$, neglecting 13% Na-pyroxene molecule), orthopyroxene ($Mg_{67\cdot4}Fe_{31\cdot6}Ca_{1\cdot0}$), garnet (pyrope-almandine with some grossular), and green-amphibole; apparently homogeneous ore, partially analysed, gave FeO 34·7, Fe_2O_3 36·4, TiO_2 25·9. Accessory pyrrhotine, niccolite, apatite, zircon, and native arsenic(?) occurred. This rock (which is analogous in composition to a picrite-basalt) is assigned to the eclogite facies. The problems of defining the eclogite facies and of distinguishing granulite facies rocks from eclogite facies rocks, are discussed. Garnets in the eclogite and granulite facies invariably have FeO/MgO greater than that of the host rock and associated pyroxenes [M.M. **31**–565].

R. St J. L.

Phemister (T. C.), Fraser (W. E.), & Williamson (D. H.). *Dalradian metamorphism and structure—Stonehaven to Aberdeen.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **13**, 352–361, 2 figs.

A series of impure feldspathic grits and sandstones with occasional shales and rare calcareous beds has been subjected to a great variety of metamorphic conditions [M.A. **12**–428]. Low to high grade schists and gneisses are developed, together with an area of increasing feldspathisation and injection of pegmatitic material marking the development of a typical migmatite complex. The mineralogy of the segregation pods, lenticles, stringers, and veins reflects that of the host rock. R. A. H.

Michel (Robert) & Berthet (Paul). *Les formations cristallophylliennes de la chaine de Belledonne dans la vallée de la Romanche (Isère).* C.R. Acad., Sci., Paris, 1958, **246**, 1888–1890.

The pre-Carboniferous crystalline formations of the Romanche region can be divided into 3 groups. (1) The highest, the Vizille group is composed of albitized leptynites (formerly 2-mica mica-schists); the metamorphism is accompanied by retrogressive metamorphism and by soda and boric metasomatism. (2) The Séchilian group consists of gneiss with amphibole and chlorite and of amphibolites of basic volcanic origin; retrogressive metamorphism is identical with the preceding, soda metasomatism is less developed. (3) The lowest—deepest—group is the Aveyna composed of heterogeneous amphibolic migmatites and normal amphibolites resting on 2-mica gneiss; late migmatitic granites occur in this group. (3) and (2) are concordant but are separated from the Vizille group by a tectonic junction. E. J. & A. S.

Sarrot-Reynauld (Jean). *Le socle cristallophyllien du Dôme de la Mure. Age et caractères du métamorphisme.* C.R. Acad. Sci., Paris, 1958, **246**, 2008–2011.

The Hercynian basement of the Dôme de la Mure (in the south of the Romanche; Belledonne massif) shows a post-Stephanian metamorphism associated with Na-metasomatism. The latter is accompanied by a front of carbonatization which affects Coal Measures strata. The Dôme de la Mure is structurally and petrographically identical with the Vizille group [preceding abstract]. The first stage of metamorphism gave 2-mica schists from the arenaceous and pelitic sediments; in the second, biotite was converted to chlorite and Fe-Ti-oxides, feldspars sericitized, and quartz recrystallized. There has also been a newer formation of chlorite, muscovite, tourmaline, and, above all, albite. The carbonate (calcite and ankerite) associated with albite formation is a kind of cafemic front. The age of the metamorphism in the Belledonne range is discussed. E. J. & A. S.

Guitard (Gérard) & Raguin (Eugène). *Sur la présence de gneiss à grenat et hypersthène (appartenant au 'faciès granulite' d'Eskola) dans le massif de l'Agly (Pyrénées Orientales).* C.R. Acad. Sci., Paris, 1958, **247**, 2385–2388.

The ancient granite and gneiss massif of Agly rises in the midst of Secondary rocks. At the base it is formed of gneiss referable to Korjinski's 'hypersthene-gneiss' facies

or to Eskola's 'granulite' facies. The gneisses of Belesta and of Caramany—two gneissic members of the massif—may be compared with Laponie's 'granulites de Saxe' and especially with the garnet-hypersthene gneiss described by Hsu from California. The garnet-hypersthene gneisses of Agly correspond to a relatively deep level of the metamorphic series of the region. E. J. & A. S.

Tobi (Alexandre C.). *Sur les roches cristallophylliennes de la bordure ouest du massif de Belledonne (Isère).* C.R. Acad. Sci., Paris, 1958, **247**, 104–106.

Probably 3 separate metamorphisms have affected this massif, the last two being Hercynian and Alpine in age. In the upper zone of the original metamorphism schists with sericite, chlorite, and porphyroblastic albite occur. The deeper crystalline rocks are heterogeneous and include mica schists, fine-grained gneisses, amphibolites, and less frequently ultrabasic rocks. The grade of the original metamorphism is higher ; it is the regional metamorphism of Harker, mesozone grade. A basic magmatic activity appears to be prior to this metamorphism ; granites and acid volcanism are in general younger. Most of the crystalline rocks have suffered more or less intense retrogressive metamorphism. E. J. & A. S.

Niggli (Ernst). *Mineral-zonen der Alpinen Metamorphose in den Schweizer Alpen.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **13**, 132–138, 1 fig.

The regional occurrence of stilpnomelane, alkali-amphiboles, chloritoid, kyanite, sillimanite, staurolite, epidote, green and brown biotite, titaniferous hematite, albite-oligoclase, and andesine in the Alpine regional metamorphism is described and discussed. Minerals indicating higher temperatures occur in and around the region of the lower Pennine nappes. The Alpine metamorphism is compared with the Caledonian metamorphism of eastern Greenland. R. A. H.

Hahn-Weinheimer (P.). *Bor- und Kohlenstoffgehalte basischer bis intermediärer Metamorphite der Münchberger Gneismasse und ihre $^{12}C/^{13}C$-Isotopenverhältnisse.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **13**, 431–442, 1 fig.

The usefulness of B and C as characteristic elements for recognizing the orthogenic or paragenic character of Münchberger eclogitic rocks has been investigated. It is suggested that the primary materials of these eclogites are Precambrian graphite-bearing, dolomitic-marl schists. R. A. H.

Smulikowski (K.). *Comments on eclogite facies in regional metamorphism.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **13**, 372–382, 2 figs.

Fine-grained two-mica migmatitic gneisses of the Śnieznik Mts. in the Eastern Sudeten [Poland] contain intercalations of amphibolites and also of eclogites. The latter contain omphacite and garnet and also varying amounts of primary, nearly colourless hornblende and primary muscovite. The amphibole and muscovite are considered to be in equilibrium with the omphacite and garnet and it is postulated that rather than being indicative of high pressures the omphacite-garnet assemblage is here the result of granitization of schists, by metasomatic reconstitution of ultrabasic intercalations, without the intervention of notably increased pressure. R. A. H.

Boulanger (Jacques). *Rétrométamorphisme des séries vohiboryennes (Madagascar).* Mémoires de l'Institut scientifique de Madagascar, série D, 1957, **8**, 199–203.

Study of the mineralogy and of the geographical distribution of the metamorphic facies of the Vohiboryian series has led the author it think that the formation of plutonic rocks, which are syntectonic but probably of late date, lowered the degree of regional metamorphism. The more highly metamorphic Precambrian series, of amphibolite facies, underwent in consequence of local retrograde adjustment a change from the mesozone to the epizone. E. J. & A. S.

Subramanian (A. P.). *Petrology of the charnockite suite of rocks from the type area around St. Thomas Mount and Pallavaram, near Madras City, India.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **13**, 394–403, 1 fig.

Charnockite is re-defined as a hypersthene-quartz-feldspar rock, with or without garnet, characterized by greenish blue feldspars and blue quartz, the dominant feldspar being a microperthite. The term charnockite suite is proposed for the genetically related charnockites, enderbites, hypersthene-quartz syenites, and alaskites of Holland's acid division. Pyroxene granulites comprising Holland's basic division have been intruded by the charnockite suite resulting in the formation of hybrid types referable to his intermediate division. [M.M. **31**–565 ; M.A. **13**–351, **14**–512] R. A. H.

Gangopadhyay (Pradeep Kumar). *Study of the metamorphic rocks around Patkum State in Manbhum.* Quart. Journ. Geol. Min. Met. Soc. India, 1959, **31**, 69–89, 15 figs.

Pelitic rocks showing progressive metamorphism with formation of chlorite, biotite, and kyanite zones are described ; almandine garnet is conspicuous by its absence. Petrographic descriptions of rocks, with optics of minerals and chemical analysis of one rock are given. A. P. S.

Ghosh (Subir Kumar). *Migmatisation in relation to regional deformation in the area around Kuilapal, W. Bengal.* Quart. Journ. Geol. Min. Met. Soc. India, 1959, **31**, 171–176, 1 fig.

A complex of permeation, augen, banded, and granite gneisses is described; their formation is attributed to synkinematic granitization of the pre-existing schistose rocks of the basement. A. P. S.

Chakravarty (P. S.). *Note on the occurrence of three aluminium silicates (andalusite, kyanite & sillinanite) near the Trijunction of Bankura, Midnapore and Purulia Districts, West Bengal.* Quart. Journ. Geol. Min. Met. Soc. India, 1960, **32**, 51–52, 4 figs.

Kyanite, andalusite, and sillimanite are reported from a garnet-staurolite-mica schist; sillimanite is considered to have inverted from kyanite and andalusite. A. P. S.

Cooray (P. G.). *Charnockite-quartzite association in the Rangala-Madulkele area, Ceylon.* Journ. Geol. Soc. India, 1960, **1**, 126–135, 1 pl., 2 figs.

Field relationship and petrographic characters of basic charnockites and associated quartzites are discussed. It is concluded that the basic charnockites of the area are metamorphosed equivalents of sediments of the Khondalite series. A. P. S.

Albers (J. P.). *Soda metasomatism in the East Shasta Copper Zinc District, Northern California, U.S.A.* Journ. Geol. Soc. India, 1960, **1**, 31–43, 2 pls., 3 figs.

Petrographic descriptions of albitized, volcanic, intrusive, and tuffaceous sedimentary rocks of mafic to felsic composition of middle Devonian to late Jurassic age, are given with five chemical analyses of rocks. Albite in these rocks is considered secondary, formed by soda metasomatism during a late Jurassic orogeny. Albitization, it is suggested, has been induced by aqueous fluids derived from one or a combination of sources such as resurgent sea water, a subjacent trondhjemite pluton, and hydrous minerals undergoing metamorphism to less hydrous types. A. P. S.

Sen Gupta (D. K.). *Agmatites of Muri-Silli-Jhalida, Ranchi and Purulia districts,* Science & Culture, 1960, **25**, 640–642.

Certain agmatites are described and, from field relationships and petrographic observations, are attributed to granitization of amphibolites and hornblende schists. A. P. S.

Rao (Janardhan Y.). *Quartz veins in the Yellandlapad rocks.* Current Sci., 1960, **29**, 17–19, 2 figs.

Quartz veins are thought to have originated by metamorphic differentiation and granitization. A. P. S.

Pichamuthu (C. S.). *Charnockite in the making.* Nature, 1960, **188**, 135–136, 2 figs.

In an area S.S.W. of Bangalore, the transformation of small localized areas of Peninsular gneiss to typical charnockite is demonstrated. M. J. Le B.

Hashimoto (Seiji). *Some notes on the geology and petrography of the southern approach to Mt. Manaslu in the Nepal Himalaya.* Journ. Fac. Sci. Hokkaido Univ., 1959, ser. iv, **10**, 95–110, 8 figs.

Report of a reconnaissance along a route extending about 180 km northwestward from Katmandu, traversing a section affected by progressive metamorphism from the phyllite zone to the culmination in migmatitic rocks. Three chemical analyses representing the series are reported, namely, a chloritoid-chlorite-sericite schist, a sillimanite-muscovite gneiss and a granitic gneiss. A. P.

Gorai (Masao). *On the metamorphic zones of the Japanese Islands.* Proc. 8th Pacific Sci. Congr. (Philippines meeting), 1956 (for 1953), **2A**, 712–715, 1 fig.

The metamorphic zones recognized in Japan are divided into three main groups, (1) Hida metamorphic zone, probably pre-Cambrian, (2) zones of late Palaeozoic to early Mesozoic age, and (3) zones of late Mesozoic to early Tertiary age. Differences between the author's interpretation of the metamorphic zones and the earlier views of Kobayashi are briefly discussed. The distribution of the metamorphic zones is outlined on a sketch-map. W. A. W.

Suzuki (Yoshio). *On the occurrence of the so-called Tsubosawa gneiss in the Kitakami district, Japan.* Journ. Fac. Sci. Hokkaido Univ., 1956, ser. iv, **9**, 337–350, 17 figs.

The Tsubosawa gneiss occurs only as enclosures in the Hikami granite mass and is partly injected along its foliation by the latter. The gneiss itself in this field may be considered mostly in the amphibolite facies but parts of it are affected by contact metamorphism due to the younger Kesengawa plutonics. A. P.

Kobayashi (Hideo). *On the cummingtonite-plagioclase rock of the Koshimizu district, Toyama Prefecture, Japan. (Studies on the Hida metamorphic rocks.* 3). Journ. Fac. Sci. Hokkaido Univ., 1953, ser. iv, **8**, 407–418, 5 figs., 2 pls., 2 tables.

The cummingtonite-plagioclase rock is intercalated

between amphibolite and biotite-garnet gneiss in a metamorphic series. Analyses of these three rocks found in association near the Koshimizu mine and another analysis of cummingtonite-plagioclase rock from a similar association at Toga river are reported. The cummingtonite-plagioclase rock is considered to have resulted from metamorphic differentiation. A. P.

Banno (Shohei). *Glaucophane schists and associated rocks in the Ōmi District, Niigata Prefecture, Japan.* Japanese Journ. Geol. Geogr., 1958, **29**, 29–44, 4 figs., 3 tables.

The regional metamorphic terrain in Omi-mati and its vicinity is divided into the chlorite and biotite zones. Representative rock types and minerals are described. Glaucophane is confined to the chlorite zone. Its occurrence shows no close relation to serpentinite. Chemical analyses are reported for four schists and two almandine garnets. [M.A. **14**–305, 506] A. P.

Yoshizawa (Hajime). *The metagabbroic rocks bearing ferriferous minerals in the Ryoke Zone, Japan.* Mem. Coll. Sci., Univ. Kyoto, ser. B, 1952, **20**, 55–68, 4 figs., 1 map, 8 tables.

Two metagabbroic bodies bearing ferriferous minerals show subparallel arrangement with the Ryoke metamorphics. One is characterized by fayalite, orthoferrosilite, ferroaugite, and andesine, and the other by ferrohypersthene, and andesine. The mafic minerals in the former resemble those of eulysites and collobrièrites ; the other rocks are similar to those once reported by Dr. S. Iwao. The writer regards these rocks as recrystallization products due to granitization, and the ferriferous olivine and pyroxenes not as relict minerals which pre-existed before the granitization, but as belonging to the granitization phase. Ferruginous schalsteins, or basic igneous rocks are considered the originals of these rocks. One analysis of fayalite-bearing metagabbroic rock, one of amphibolitic granulite, and three of granitized rocks are reported. A. P.

Yoshizawa (Hajime). *A supplement to 'The metagabbroic rocks bearing ferriferous minerals in the Ryoke Zone, Japan'.* Mem. Coll. Sci., Univ. Kyoto, ser. B, 1955, **22**, 237–241.

On further study of these metagabbroic rocks [see preceding abstract] the author considers it more probable that they are ferriferous gabbros, contaminated by salic materials, which were injected into the Ryoke sedimentaries as sills and later were affected by metasomatism due to granitic magma which was intruded after their consolidation. A. P.

Nakayama (Isamu). *On the geological structure of the low grade metamorphic region in the south of River Kinokawa and petrofabric of quartz in the quartz schist of the region* Mem. Coll. Sci., Univ. Kyoto, ser. B, 1958, **24**, 335–352, 27 figs., 1 pl., 2 tables.

Several types of quartz schist are intercalated in a series of 5 formations of metamorphic rocks with an aggregate thickness of about 2000 m. The quartz fabric of the quartz schists is pictured in 25 diagrams, mostly based on 200 measurements each. Several types of quartz fabric are distinguished and their development discussed. A. P.

Kumagai (N.) & Ito (H.). *On the* P-T *diagrams of the trimorphic minerals of Al_2SiO_5, with special reference to andalusite and cyanite as a geologic thermometer or a geologic piezometer.* Mem. Coll. Sci., Univ. Kyoto, ser. B, 1959, **26**, 215–223, 3 figs.

From differences in Gibbs free energies calculated by the second law of thermodynamics, the P-T diagrams are given with reference to sillimanite, andalusite, and kyanite. It is suggested that andalusite is stable at high temperature and low pressure, kyanite at high pressure and low temperature, and sillimanite at intermediate values. The temperature of magma from which the andalusite-bearing granite is made should be above 1760°K. The pressure during dynamometamorphism to produce kyanite should be about 50,000 atm. Impurities in these minerals have some effect on the P-T conditions of transformation. M. S. J.

Seki (Yotaro), Aiba (Mizuo), & Kato (Chigusa). *Jadeite and associated minerals of metagabbroic rocks in the Sibukawa District, Central Japan.* Amer. Min., 1960, **45**, 668–679, 4 figs.

Jadeite from the above locality is associated with lawsonite, pumpellyite, chlorite, vesuvianite, and grossular. The chemical, optical, and X-ray data are given for jadeite and some associated minerals. It is postulated that jadeite was formed under high water pressure at low temperature during the Sanbagawa metamorphism. A. C. H.

Coombs (D. S.). *Lower grade mineral facies in New Zealand* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **13**, 339–351, 2 figs.

The zeolite facies is reviewed and a prehnite-pumpellyite metagreywacke facies is described. It is defined to include the assemblages produced under physical conditions in which quartz-prehnite-chlorite or quartz-albite-pumpellyite-chlorite associations are commonly formed, without zeolites and without the characteristic minerals (jadeite or lawsonite) of the glaucophane schist facies. This bridges a gap between the zeolite and greenschist facies. Lawsonite

etagreywackes and lawsonite marble from the Maitai roup (Permian), in the Nelson district, are described. awsonite-quartz-chlorite assemblages should be favoured higher pressure or lower temperature than those with umpellyite. Hydrothermal crystallization of wairakite M.M. **30**–691], anorthite, and montmorillonite is reported om kaolin-calcite-quartz mixes. R. A. H.

HESTERMAN (C. W.). *Intrusive ultrabasic rocks and their metamorphic relationships at Leech Lake Mountain, Mendocino County, California.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **13**, 208–215, 4 figs.

Serpentinite sills show intrusive contacts with tuffaceous reywackes of the Franciscan formation at Leech Lake fountain. The ultrabasic rock is considered to have been ntruded as a liquid magma and has superimposed glaucohane schist facies metamorphism on the greywackes with ne formation of jadeitic pyroxene and rare blue sodic mphibole. The intrusion was accompanied by a hydrohermal phase which caused partial serpentinization of the reywacke at the immediate contact and which also formed eins of nephrite, jadeitic pyroxene, prehnite, hydrorossular, and vesuvianite in the serpentinite, and veinlets f pectolite, xonotlite, or calcite in the greywacke. ocally the serpentinite has intruded diabase sills ; at ne contact the diabase was altered to a chlorite-serpentineaersutite-actinolite-pumpellyite rock. R. A. H.

EN (E-AN.). *Petrology of Lower Palaeozoic rocks from the slate belt of western Vermont.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **13**, 362–371, 4 figs.

Stilpnomelane-bearing rocks and chloritoid-bearing rocks re intimately associated, bulk composition rather than hysical conditions of metamorphism determining which ineral is stable. Both chloritoid and stilpnomelane occur rocks of very low metamorphic grade. Analyses of tilpnomelane from the literature are plotted on three ifferent assumptions and as a result the assumption that ll ferric iron represents oxidized ferrous iron of the original ineral is tentatively adopted. R. A. H.

LLARD (GILLES O.). *The Dore Lake Complex : a metamorphosed layered complex (Chibougamau District, Quebec).* Virginia Journ. Sci., 1959, **10**, 292–293.

A brief description is given of the Dore Lake Complex hich is 27 miles long and approx. 10,000 feet thick. northosite and gabbroic anorthosite originally formed the ain layer of the mass. Regional metamorphism (greenchist facies) changed it to meta-anorthosite, a mixture of lbite, zoisite, and/or clinozoisite, and chlorite. Copper ore pdies occur in certain fractures in the complex.

R. S. M.

REDDEN (J. A.). *Some metamorphic features of the Precambrian rocks of the Southern Black Hills, South Dakota.* Virginia Journ. Sci., 1959, **10**, 292.

R. S. M.

ZEN (E-AN.). *Metamorphism of Lower Paleozoic rocks in the vicinity of the Taconic Range in west-central Vermont.* Amer. Min., 1960, **45**, 129–175, 6 figs.

Most of the rocks are arenaceous, of early Cambrian to middle Ordovician age, and are from the Taconic allochthon. The mineral assemblages are : muscovite-chlorite-quartz ; muscovite-paragonite-chlorite-chloritoid-quartz; muscovite-chlorite - chloritoid - epidote - hematite - magnetite - quartz ; muscovite-stilpnomelane-chlorite-albite-microcline-quartz ; muscovite - biotite - quartz - graphite ; calcite - dolomite - chlorite-muscovite ; calcite-zoisite-chlorite. They are studied by phase diagrams. Chemical analyses and optical data are given for two chlorites (ripidolite) and one chloritoid. Chemical and modal analyses are presented for four phyllites. A. C. H.

BLOXAM (T. W.). *Jadeite-rocks and glaucophane-schists from Angel Island, San Francisco Bay, California.* Amer. Journ. Sci., 1960, **258**, 555–573.

Jurassic Franciscan arkosic graywackes with a little conglomerate and radiolarian chert have been metamorphosed to jadeitic rocks independently of proximity to basic or ultrabasic intrusions. The feldspar of a diabase sill intrusive in the sediments is changed to chlorite, lawsonite, and jadeite. Analyses of 14 rocks (10 being new) from the area show that the metamorphism involved removal of SiO_2 and addition of Fe, Mg, Ca, Ti, and perhaps Na. Glaucophane schist and jadeitic metagraywackes form tectonic inclusions in hydrothermally serpentinized pyroxenite dikes. Jadeite is stable in the arkosic metagraywackes that are deficient in Fe, Mg, and Ca, but acmite-jadeite and glaucophane take its place in the glaucophane schists. The glaucophane schists are at least partly produced by hydrothermal metamorphism. H. W.

DAVIS (GREGORY A.). *Lawsonite and pumpellyite in glaucophane schist, North Berkeley Hills, California.*

PABST (A.). *With notes on the X-ray crystallography of lawsonite.* Amer. Journ. Sci., 1960, **258**, 689–704.

A new lawsonite-pumpellyite occurrence, with exceptional development of lawsonite as veins and lithologic layers in glaucophane schist (calculated analysis given) is a tectonic block in serpentinite, believed to be at least partly due to retrograde metamorphism of eclogite.

Pumpellyite occurs in veins as bundles or matted aggregates of bladed crystals up to 2 cm long, with interstitial chlorite or calcite ; it is sometimes tabular on {100}

and bounded by poor {100} and {$\bar{1}02$} or {102}. Optical properties are β_{Na} 1·689, $2V_{\gamma Na}$ 51°–52°, with very strong dispersion $2V_\gamma$ (*red*) 51°–52°, $2V_\gamma$ (*violet*) 57°–59°, $\gamma : c$ 8°, pleochroism, $\alpha = \gamma$ colourless, β bright apple green; abnormal blue and brown interference colours in some orientations; sp. gr. 3·16±0·001. Semi-quantitative spectroscopic analysis gave Ca, Si, Al as principal constituents, total Fe as Fe_2O_3 5·4, TiO_2 0·5, Cr_2O_3 0·01, MgO 5·0, MnO_2 0·1–0·5, Na_2O 0·1–0·2, V_2O_5 0·1, Ni 0·002, Ga 0·005, anal. G. M. Gordon.

Lawsonite forms metamorphically or hydrothermally emplaced, discontinuous layers in the glaucophane schist, which contain 71 lawsonite, 20 glaucophane, 6 pyrite, 1·3 sphene, 1·3 pyroxene, and 0·1 each of muscovite and apatite vol. per cent. Its physical properties are: α ($\|c$) 1·665±0·002, β ($\|a$) 1·673±0·002, γ ($\|b$) 1·686±0·002, $2V_\gamma$ (Na) 79°–85°, $r > v$ weak; sp. gr. 3·07±0·01; cell dimensions a 8·788±0·008, b 13·129±0·010, c 5·846±0·006 (averages of one or more determinations on crystals from three localities in California and one in Cuba). Indexed X-ray powder data include as strongest lines and intensities d =2·264/10, 1·550/8, 2·726/7, 4·84/6, 3·66/6, 2·433/6, 2·129Å/6. Chemical analysis gave SiO_2 38·14, Al_2O_3 30·91, Fe_2O_3 1·56, FeO 0·13, MgO 0·03, CaO 17·54, Na_2O 0·06, K_2O 0·14, H_2O 10·72, TiO_2 0·29, MnO 0·01, = 99·53, total ign. loss 11·40, theoretical total H_2O 11·42, anal. Doris Thaemlitz. Lawsonite decomposes slowly at 410°C, and rapidly at 700°C, to hexagonal $CaAl_2Si_2O_8$, and some of this (brown) material was found associated with the remains of old campfires a few yards from the main outcrop of lawsonite. H. W.

Koschmann (A. H.). *Mineral paragenesis of Precambrian rocks in the Tenmile Range, Colorado.* Bull. Geol. Soc. America, 1960, **71**, 1357–1370, 2 figs., 8 pls.

A Precambrian complex of granulite, gneiss, and migmatite, intruded by numerous plutons of granitic rocks correlated with the Silver Plume granite, is exposed in a long narrow belt in the Tenmile Range. The metamorphic rocks, predominantly felsic, contain layers, lenses, and irregular bodies of mafic rocks rich in biotite, hornblende, and locally in sillimanite and garnet. The major lithologic variations are believed due to variations in the original sediments. The Silver Plume granite includes many small, apparently isolated, patches and pods, some only 10–100 ft. in diameter; the larger bodies are extremely ramifying and discordant. Textures are described in detail and used to formulate a paragenetic sequence. Textural paragenetic relations identical with those in the complex are found in the Silver Plume granite, and the writer concludes that the granite was derived by partial fusion of quartzose metamorphic rocks. A. L. A.

Choquette (Philip W.). *Petrology and structure of the Cockeysville formation (Pre-Silurian) near Baltimore, Maryland.* Bull. Geol. Soc. America, 1960, **71**, 1027–1052, 8 figs., 3 pls.

The Cockeysville formation is a series of intricately folded carbonate-rich metasedimentary rocks, about 750 feet thick, lying near the base of the Glenarm series which mantles domes of basement gneiss. It is composed mostly of crystalline metadolomite, calc-schist, and calcite marble. Metamorphic grade remains essentially constant throughout the mapped area; variations in the mineral assemblages would allow assignment to several metamorphic subfacies but they may have arisen from locally varying conditions of vapour (CO_2 and H_2O) pressure and of composition. Metasomatism of the recrystallized sediments is restricted to the aureoles around mafic and granitic dikes. A. L. A.

Mueller (Robert F.). *Compositional characteristics and equilibrium relations in mineral assemblages of a metamorphosed iron formation.* Amer. Journ. Sci., 1960, **258**, 449–497.

The 4 most significant assemblages are: cummingtonite, Ca-pyroxene, actinolite, magnetite, calcite, quartz; actinolite, talc, magnetite, hematite, calcite, dolomite, quartz; cummingtonite, actinolite, talc, magnetite, hematite, quartz; Ca-pyroxene, actinolite, magnetite, hematite, calcite, quartz. Spectrochemical analyses of 26 actinolites, 17 Ca-pyroxenes, and 29 cummingtonites, and of 6 different rocks containing them provide data on the relations between ratios Mg : Mg+Fe and Mn : Mg+Fe+Mn, in pairs of co-existing minerals actinolite+Ca-pyroxene, cummingtonite+Ca-pyroxene, and cummingtonite+actinolite. Refr. ind. β is reported for 26 actinolites. Distribution constants derived for the several assemblages in turn, show that chemical equilibrium was approached remarkably well, and indicate a lack of any significant introduction of material from outside the system. H. W.

Volcanology

Clements (T.). *Criterios para determinar la edad del material volcánico Cuaternario.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 3–8. R. A. H.

Ma (Ting Ying H.) & Pan (Chia Lin). *Volcanic belts discussed with respect to the shifting of crustal masses due to the Cenozoic sudden total displacements of solid earth shell.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 9–17, 3 figs. R. A. H.

Richards (A. F.). *Volcanism in eastern Pacific ocean basin :* 1945–1955. 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 19–31, 4 figs.

R. A. H.

Bellair (P.). *Le volcanisme de l'Afrique septentrionale.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 35–45, 5 figs.

R. A. H.

McCall (J. D. H.). *Natural steam as a possible source of power in the Rift Valley of Kenya.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 47–54, 1 fig.

R. A. H.

McCall (J. D. H.). *The Menengai caldera, Kenya Colony.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 55–69, 4 figs.

A caldera of Krakatoan type was formed by the rapid emptying of the magma chamber during the later stages of trachyte eruption, when a series of explosive eruptions scattered ash over the surrounding country. R. A. H.

Fúster (J. M.). *Evolución magmática de la Provincia de la Guelaya (norte de Marruecos).* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 71–100, 4 figs.

The petrogenesis of this Spanish Moroccan volcanic series is illustrated by means of 32 rock analyses, ranging from rhyolites, rhyodacites, and andesite to basalts.

R. A. H.

Westerveld (J.). *Phases of Neogene and Quaternary volcanism in Asia Minor.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 103–119, 4 figs.

R. A. H.

Bentor (Y. K.). *Cenzoic volcanism of Israel.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 121–136, 1 fig.

In south-east Galilee the nepheline-basalt and nephelinite of Giv'ath Hamore intrude Eocene chalk and limestone and are cut by small veins of coarse aegirine-nepheline syenite. Pleistocene dykes carry barkevikite crystals up to 5 cm in length. R. A. H.

Ishikawa (T.), Minato (M.), Kuno (H.), Matsumoto (T.), & Yagi (K.). *Welded tuffs and deposits of pumice flow and nuée ardente in Japan.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 137–150, 1 fig.

R. A. H.

Morimoto (R.). *The volcanic rock fragments embedded into the debris of No. 5 Kaiyo Maru, hit by a submarine explosion near the Bayonnaise rocks off Japan.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 151–159, 5 figs.

The 211-ton survey ship No. 5 *Kaiyo Maru* was hit by a volcanic explosion and sunk. A pyroxene crystal was found embedded in a lifebuoy ; a lump of dacitic pumice embedded in a provision barrel has been analysed : 3 other analyses of ejectamenta of this explosion are also given.

R. A. H.

Morimoto (R.), Huzita (K.), & Kasama (T.). *Cenozoic volcanism in south-western Japan with special reference to the history of the Setouchi (Inland Sea) geologic province.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 161–170, 2 figs.

Chemical analyses are given for 13 andesites, liparites, and basalts from lavas near Osaka. R. A. H.

Karrenberg (H.). *Junger Magmatismus und Vulkanismus in Südwestarabien (Jemen).* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 171–185, 2 figs.

R. A. H.

Cook (E. F.). *Stratigraphic and structural utility of layered volcanic rocks.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 189–203, 4 figs.

In south-west Utah individual ignimbrites have been traced over distances greater than 50 miles. R. A. H.

Chesterman (C. W.). *Volcanic lightweight aggregates of western United States.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 205–229, 5 figs.

A report on pumice, perlite, and volcanic cinders (scoria), including 2 new chemical analyses of rhyolitic pumice and 4 of rhyolitic perlite. R. A. H.

Thayer (T. P.). *Some relations of later Tertiary volcanology and structure in eastern Oregon.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 231–245, 5 figs.

R. A. H.

Munck (S.) & Noe-Nygaard (A.). *Age determination of the various stages of the Tertiary volcanism in the west Greenland basalt province.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 247–256, 1 fig.

R. A. H.

Anda (L. F. de). *El campo de energía geotérmica en Pathé Estado de Hidalgo, México.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 257–283, 6 figs.

R. A. H.

Schulze (G.). *Estudio sobre la naturaleza de las formaciones riolíticas al este de la ciudad de Zacatecas.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 285–315, 7 figs., 2 pls.

R. A. H.

Schulze (G.). *Replacement of Tertiary bedded red conglomerate by rhyolitic formations.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 317–336.

R. A. H.

Mooser (F.). *Los ciclos de vulcanismo que formaron la Cuenca de México.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 337–348.

R. A. H.

Bullard (F. M.). *Active volcanoes of Central America.* 20th Congr. Geol. Intern., Mexico, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 351–371, 2 figs., 4 pls.

A report on currently active volcanoes in Costa Rica, Nicaragua, El Salvador, and Guatemala.

R. A. H.

Müller (G.) & Veyl (G.). *The birth of Nilahue, a new maar type volcano at Riñinahue, Chile.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 375–396, 9 figs., 2 pls.

A vent opened on July 27th, 1955, giving a total ejection of 520 million tons of ash, of an average composition of 17·5% basalt and diorite fragments and 82·5% fused basaltic pumice ; partial chemical analyses are given.

R. A. H.

Noe-Nygaard (A.) & Rasmussen (J.). *The making of the basalt plateau of the Faröes.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 399–407, 1 fig.

R. A. H.

Vilar (F. Macau). *Los volcanes del cenozoico en Gran Canaria, causas y consecuencias de su singular distribución en la isla.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 409–424, 7 figs.

R. A. H.

Vilar (F. Macau). *Los tubos volcánicos originarios de manantiales.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 425–437, 4 figs.

R. A. H.

Jung (J.), Michel (R.), & Brousse (R.). *Caractères magmatiques régionaux du volcanisme récent de l'Auvergne (Massif Central Français).* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 439–450, 4 figs.

R. A. H.

Klüpfel (W.). *Das Wesen des Altvulkanismus und die Baugeschichte des Cantal (Auvergne).* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanologia del Cenozoico, pp. 451–468, 1 fig.

R. A. H.

Lauro (C.) & Deriu (M.). *Il vulcanismo cenozoico in Sardegna : le manifestiazioni 'oligoceniche'.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanología del Cenozoico, pp. 469–486.

Sardinian vulcanicity is discussed and 126 analyses are quoted.

R. A. H.

Smulikowski (K.). *Tertiary lavas of Lower Silesia.* 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanología del Cenozoico, pp. 487–494.

R. A. H.

[Dzotsenidze (G. S.)] Дзоценидзе (Г. С.) Палеогеновый грузии связим вулканизм в тектогенезом [? вулканлзм Грчзии в связи с тектогенезом] [*Palaeogene volcanism of Georgia in connection with tectogenesis*]. 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanología del Cenozoico, pp. 495–509, 2 figs., 1 table. [English summary]

S. I. T.

[Favorskaya (M. A.)] Фаворская (М. А.). Верхнемеловой и кайнозойский вулканизм Сихотэ-Алиня [*Upper Cretaceous and Kainozoic vulcanism in Sikhote-Alin*]. 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanología del Cenozoico, pp. 511–519, 3 figs. [English summary]

S. I. T.

[Vlasov (G. M.)] Власов (Г. М.). История кайнозойского вулканизма тихоокеанских окраин СССР [*The history of Kainozoic vulcanicity of the Pacific border of U.S.S.R.*]. 20th Congr. Geol. Intern., México, 1960, Seccion 1, Vulcanología del Cenozoico, pp. 521–543, 7 figs., 2 tables. [English summary]

S. I. T.

Smith (Robert L.). *Ash flows.* Bull. Geol. Soc. America, 1960, **71**, 795–842, 6 figs., 2 pls.

This is a critical review of ash flows, particularly welded tuffs. Among the major subjects discussed are : (1) petrographical characteristics and criteria for the recognition of ash flows, (2) recognition and definition of units, (3) mode of eruption, (4) eruptive vents and source areas, (5) magnitude of known deposits, and (6) origin of the magmas. A. L. A.

Fisher (Richard V.). *Classification of volcanic breccias.* Bull. Geol. Soc. America, 1960, **71**, 973–982. A. L. A.

Murata (K. J.). *Occurrence of CuCl emission in volcanic flames.* Amer. Journ. Sci., 1960, **258**, 769–772.

CuCl is present in small amount. H. W.

Williams (Howel). *Volcanic history of the Guatemalan Highlands.* Berkeley and Los Angeles (Univ. of Calif. Press), Univ. California Publ. Geol. Sci., 1960, **38**, 1–86, 6 figs., 13 pls., 2 maps. Price $2.00.

A superbly illustrated, comprehensive description of the geology, geomorphology, and volcanic history of the Guatemalan highlands. Major sections are devoted to the Tertiary volcanic rocks, the Quaternary cones and domes and the Quaternary pumice deposits. A. P.

Williams (Howel). *Volcanic collapse-basins of Lakes Atitlan and Ayarza, Guatemala.* Rept. 21st Intern. Geol. Congr., Norden, 1960, Part **21**, 110–118, 4 figs.

Atitlan Lake represents neither a caldera nor a volcano-tectonic sink but is due to a cauldron subsidence caused principally by collapse resulting from subterranean withdrawal of magma. Lake Ayarza is a caldera of Krakatoan type, caused by collapse as a result of colossal eruptions of pumice. R. A. H.

Hay (R. L.). *Formation of the crystal-rich glowing avalanche deposits of St. Vincent, B.W.I.* Journ. Geol., 1959, **67**, 540–562.

While crystals form only about 45% of the material of the bombs, they comprise 73% of the ash finer than 2 mm. This is attributed to concentration of the crystals in the lower parts of the moving glowing avalanches because of their greater density and to removal of the vitric ash to greater distances in the upper parts of the glowing avalanches and in the ash clouds proper. A similar mechanism of concentrations of crystals is suggested for the pumice flows of Crater Lake and Asama. R. E. W.

Segerstrom (Kenneth). *Erosion and related phenomena at Paricutin in* 1957. Bull. U.S. Geol. Survey, 1960, **1104-A**, 1–18.

Compaction of the ash mantle was very small in 10 years (1947–1957), but erosion and redeposition of transported material were very great. K. S.

Rawson (D. E.). *Drilling into molten lava in the Kilauea Iki volcanic crater, Hawaii.* Nature, 1960, **188**, 930–931, 1 fig.

The crust of the lava lake of the November 1959 eruption was pierced. A temperature of 1064°C was measured for the underlying molten rock from which gas and lava samples were collected for analysis. The analyses and discussion will be published elsewhere. M. J. Le B.

Sakai (H.) & Nagasawa (H.). *Fractionation of sulphur isotopes in volcanic gases.* Geochim. Cosmochim. Acta, 1959, **15**, 32–39, 2 figs.

$^{34}S/^{32}S$ ratios are given for SO_2 and H_2S from 7 fumaroles of Showashinzan volcano, Japan. In SO_2 the ratio $^{34}S/^{32}S$ varies inversely with the outlet temperatures (99°–661°C) of the fumaroles, but in H_2S it is apparently independent of the outlet temperature. R. C.

Ishikawa (Toshio) & Katsui (Yoshio). *Some considerations on the relation between the chemical character and the geographical position of the volcanic zones in Japan.* Journ. Fac. Sci. Hokkaido Univ., 1959, ser. iv, **10**, 163–183, 5 figs., 4 tables.

The Pleistocene and recent volcanoes of Japan and the Kurile Islands are classified geographically into four principal zones and numerous subzones. The results of over 400 rock analyses, which are not quoted but for all of which literature references are given, are used in considering the chemical relations within and among the several zones. Relations to major structural features are discussed and compared with relations found by Rittmann [Bull. Volc., 1953, ser. 2, **14**, 45–58] for Indonesian volcanoes. A. P.

Ishikawa (Toshio). *The chemical characteristics of the lavas from Volcano Tarumai, Hokkaidô, Japan.* Journ. Fac. Sci. Hokkaido Univ., 1952, ser. iv, **8**, 107–135, 10 figs., 3 tables.

Eighteen analyses of lavas (SiO_2 56·50 to 61·32) from the volcano Tarumai and the adjacent area are reproduced from the literature, their Niggli values tabulated, variation diagrams constructed and compared with other volcanic rocks of Japan. It is concluded that the lavas from the volcano Tarumai are closely related and derived from the same magma. A. P.

Aramaki (Shigeo). *The* 1783 *activity of Asama volcano. Part I.* Japanese Journ. Geol. Geogr., 1956, **27**, 189–229, 20 figs., 2 pls., 3 tables, 2 maps.

—— —— *Part II.* Ibid., 1957, **28**, 11–33, 3 tables.

In part I the geology of the volcano is summarized and the nature of the 1783 activity, as inferred from old records, tabulated. Products of the principal phases of activity are described in detail. In part II the mechanism of eruption is discussed, and four new analyses of products of the 1783 activity (SiO_2 62·27, 60·76, 62·37, and 60·28) reported. A. P.

Isshiki (Naoki). *Ao-ga-sima volcano.* Japanese Journ. Geol. Geogr., 1955, **26**, 209–218, 1 fig., 3 tables.

The geomorphology and geology of the volcano, one of the seven Izu Islands, are described and 3 chemical analyses of the lavas, olivine basalt, aphyric basalt, and augite andesite, reported. A. P.

[Svyatlovskiĭ (A. E.)] Святловский (А. Е.). Атлас вулканов СССР [*Atlas of volcanoes of the U.S.S.R.*]. Изд. Акад. Наук СССР [Publ. Acad. Sci. U.S.S.R.], 1959, 174 pp., 322 figs., 2 maps. Size $14\frac{1}{2} \times 11\frac{1}{2}$ in. Price 38r. 50k.

The title may perhaps mislead the reader for the book contains only two rather diagrammatic maps—one of Kamchatka, the other of the Caucasus, besides a number of small sketch maps. It consists mainly of reproductions of aerial photographs of volcanoes and volcanic regions of the U.S.S.R. The choice of subjects and the originals may be excellent but the reproduction is not always up to a high standard. Some photo-reproductions are in addition illustrated by small sketch maps and all of them are accompanied by a very informative text. A good account is presented of Kamchatka volcanoes (pp. 11–113) and of the Caucasian volcanoes (pp. 117–164) but Kurile Island volcanoes and certain Siberian volcanoes are not described. In spite of slight imperfections of printing this collection of photographs giving splendid aerial views of cones, craters, calderas, lava flows, and other volcanic features is extremely interesting and valuable for a student of volcanology and geomorphology. Brief explanatory notes in English (pp. 165–170) add to the value of this book. A short glossary and bibliography (pp. 171–172) complete the book. S. I. T.

Набоко (S. I.)] Набоко (С. И.). Вулканические эксгаляции и продукты их реакций [*Volcanic exhalations and the products of their reactions*]. Тр. Лаб. Вулк. Акад. Наук СССР [Trans. Lab. Volcanology Acad. Sci. U.S.S.R.], 1959 no. 16, 303 pp., 80 figs. Price 16r. 70k.

This is an extensive work based mainly on the study of the volcanoes of Kamchatka, comprising 28 active and 150 extinct volcanoes, two groups of geysers, and over 100 groups of thermal springs. It contains numerous chemical analyses of gases, thermal waters, minerals, and rocks, as well as many thermal curves and some X-ray data. Descriptions of processes and products are followed by comparison with those described from other regions of the world and many interesting and significant generalisations are outlined. To this brief notice it may be added that Part I (pp. 7–58) provides the description of the post-volcanic processes, namely those involving exhalations such as fumarolas, moffetes, solfataras and hydrosolfataras, of which a new scheme of classification is given. S. I. T.

West (W. D.). *The source of the Deccan Trap flows.* Journ. Geol. Soc. India, 1960, **1**, 44–52, 1 fig.

On the evidence of a single flow unit which can be traced over long distances in the Deccan basalt country, the flows are considered extremely fluid ; the possible causes for their fluidity discussed. It is concluded that the Deccan lavas were erupted through fissures, now seen as dykes, and that the major foci were off the west coast in Sourashtra, and up the Tapti and Narmada valleys. A. P. S.

Verhaeghe (Marcel A. P.). *Le volcan Mugogo.* Institut des Parcs Nationaux du Congo. Exploration du Parc National Albert. VIII. Mission d'études vulcanologiques, 1958, fasc. 3, pp. 3–29, 6 figs., 4 pls.

The account of a short eruption in August 1957, in the central part of Virunga, Congo. The eruption occurred 11 km north of the principal cone of the Visoke volcano. In the course of 42 hours of activity about 750 000 m³ of molten products were emitted. Specimens collected from bombs and flow show uniform mineralogical composition ; five analyses class the lavas as ankaratrite. [M.A. **15**–55] F. Sch.

Sahama (Thure G.) & Meyer (A.). *Study of the volcano Nyiragongo. A progress report.* Institut des Parcs Nationaux du Congo belge. Exploration du Parc National Albert. VIII. Mission d'études vulcanologiques, 1958, fasc. 2, 1–85, 3 figs., 1 map, 8 tables, 3 pls.

A physiographical description is given of Nyiragongo volcano, comprising the lateral units Shaheru and Baruta, the final cone, central crater, and the laval plain south and east of the volcano. A suitable terminology having been discussed, specimens from those parts and from the flow and satellite cones around the principal edifice are described. All the lavas lack feldspar completely and belong to the family of leucite-nephelinites and melilitites. Their

inerals are leucite, nepheline, K-nepheline kalsilite 'microerthite', and melilite, with accessory clinopyroxene, ores, patite, &c., and more rarely olivine. The new minerals escribed by Sahama and his colleagues include götzenite M.A. **15**–132], kirschsteinite, combeite, as well as calcic livine [M.A. **14**–60, 140, 199, 207]. Abundant numerical data include chemical analyses and corresponding Niggli values and norms of rocks, analyses and optical properties of clinopyroxenes and melilite, an analysis of leucite and of apatite, and optical properties of apatite and nepheline ; unit cell data are given for melilite and apatite.

M.-E. D.

TOPOGRAPHICAL MINERALOGY

ANON. *A beryl crystal from Scotland.* Rocks and Minerals, 1960, **35**, 252–253, 1 fig.

A 9½ pound beryl crystal was recently collected fror an bandoned pegmatite on Loch Nevis, Knoydart, Scotland.

R. S. M.

MANNING (P. I.). *New mineral records from County Down, Northern Ireland.* Irish Natur. Journ., 1960, **13**, 167.

Pyromorphite in lime-green and yellowish-green crystals, ometimes as groups of parallel prisms, occurs on barytes nd on rock fragments of the mineralized breccia of the Newtownards-Conlig lode. Specimens are from spoil heaps 300 yards N.W. of Windmill. Molybdenite collected from Mourne (G2) Granite close to the G2/G3 contact was found 250 yards N. of the N. tip of Blue Lough, Annalong valley. Both identifications were confirmed by X-ray examination.

J. P.

WALKER (G. P. L.). *The amygdale minerals in the Tertiary lavas of Ireland. IV. The crystal habit of calcite.* Min. Mag., 1960, **32**, 609–618, 2 figs.

Calcite is widespread in association with zeolites in the mygdales and veins in the Antrim basalts [M.M. **32**–503]. The characteristic forms are $\{02\bar{2}1\}$ and a steep scalenohedron in the zone $[\bar{1}101]$, usually $\{13.11.\bar{2}\bar{4}.2\}$. Crystals rom a basalt quarry on Baird's Brae, Roughfort, have aces of $\{16.1.\bar{1}7.0\}$ a form not before described for calcite. M.M. **17**–274]

R. A. H.

MORGAN (ALAN). *The geology of Barry Island, south east Glamorgan, Wales.* Rocks and Minerals, 1960, **35**, 223–225, 3 figs.

Galena, calcite, aragonite, and chert occur in Carboniferous limestone ; compact baryte and chalcopyrite in Keuper breccia, pale blue baryte crystals in geodes in green marl ; pyrite occurs in Lias shale.

R. S. M.

JOHAN (ZDENĚK). [*A vanadium-containing cuprite from Popelky near Lomnice on Popelka (Czechoslovakia)*]. Acta Univ. Carolinae, Geologica, Prague, 1960, no. 1, 51–59, (Czech with Russian and English summaries).

The author investigated the hydrothermal paragenesis of melaphyres from Popelky near Lomnice on Popelka in northern Bohemia. Together with native copper and silver, chalcocite, chrysocolla, calcite, and quartz was found cuprite containing appreciable quantities of vanadium. Through weathering of cuprite, vesignieite $Cu_3Ba(VO_4)_2(OH)_2$ [M.A. **13**–6] is formed in this locality. It follows from the geochemical evolution of hydrothermal paragenesis that of the primary minerals only cuprite contains vanadium. The presence of vanadium in the cuprite crystal lattice is discussed with respect to ionic and homoeopolar linkages.

J. N.

ČERNÝ (P.). [*Milarite and wellsite from Věžná*]. Acta Akad. Sci. Čechoslov. Basis Brunensis, 1960, **32**, op. 399, 1–16, (Czech with English summary).

Milarite and wellsite were found in pegmatite veins near Věžná, western Moravia, Czechoslovakia. Milarite crystals are columnar, acicular or fibrous, 3–15 mm, strictly uniaxial negative, without optical anomalies. Wellsite forms skeleton aggregates of twinned crystals in a vein of oligoclasite, penetrating serpentinite. The twinned crystals are mainly Marburg fourlings ; morvenite twins, Périer fourlings and Stempel complex twins are rare. J. N.

STANĚK (J.). [*Montebrasite, augelite and lazulite from Otov*]. Acta Akad. Sci. Čechoslov. Basis Brunensis, 1960, **32**, op. 400, 17–32, (Czech with German summary).

Forty minerals are found in the pegmatite from Větrnný vrch [hill] near Otov, western Bohemia, Czechoslovakia. The principal associated phosphates here are triphylite, graftonite, and heterosite. In this paper the rare Al-phosphates montebrasite, augelite, and lazulite are reported found.

J. N.

WEIBEL (M.). *Zweifarbiger Fluorit aus dem Val Nalps* [Tavetsch, Graubünden, Switzerland]. Schweiz. Min. Petr. Mitt., 1960, **40**, 411–412, 1 fig.

An unusually large (4 inch) octahedral crystal of fluorite found in an Alpine vein is described. The core of the crystal is rose-red, the outer zone light-green. M. G.

MONTAL (JUAN). *Quartz and scheelite in Spain.* Rocks and Minerals, 1956, **31**, 563–566, 5 figs.

Several scattered occurrences of quartz crystals, including citrine and cinnabar-impregnated types, are mentioned. Scheelite and wolframite occur at several places in Spain; material from the Barruecopardo district, near Villasbuenas, in the province of Salamanca, is briefly described. Reinite and arsenopyrite also occur in the district. R. S. M.

[Shashkina (V. P.)] Шашкина (В. П.). Цеолиты из базальтов Волыни [*Zeolites from the basalts of Volhynia*]. Мин. Сборник Львовского Геол. Общ. [Min. Mag. Lvov Geol. Soc.], 1958, **12**, 380–395, (English summary).

Hydrothermal minerals from the ancient volcanic rocks of western Volhynia are found to contain zeolites as well as minerals of the silica group, sulphides, calcite, baryte, chlorite, etc. Laumontite, thomsonite, heulandite, ptilolite, and a red variety of analcime transitional to palagonite are optically described and some X-ray data given. The red analcime, n 1·500±0·005, is found to have a high iron content. N. R.

Gil-Av (E.), Heller (S.), & Steckel (F.). *The Um Barek oil shale*. Bull. Res. Council Israel, 1954, **4**, 136–143, 4 figs., 6 tables.

The calcareous oil-shales found on the western shore of the Dead Sea, Israel, contain 2–10% oil (5–20% total organic matter). Small amounts of pyrite and phosphates are present. Elemental analysis and organic solvents extraction assays of kerogen are given; the high sulphur content of kerogen is notable. D. H. Y.

Czayo (Sylvia E.). *Gypsum cave in Iran*. Rocks and Minerals, 1960, **35**, 331–332.

Fayaz (Hashem). *Mesgarabad Mine, Iran*. Rocks and Minerals, 1960, **35**, 333–335, 7 figs.

Gypsum crystals up to 40 cm long and 13 cm across occur in a cave (9×3·5×5·5 meters) opened during the exploitation of the Mesgarabad Mine (masonry lime) 10 km (6 miles) east of Tehran towards Mt. Damavand. The crystals range from colourless, white, grey, to yellow-brown and are twinned; some contain inclusions of water, mud, and sand. R. S. M.

Cooray (P. G.) & Kumarapeli (P. S.). *Corundum in biotite-sillimanite gneiss from near Polgahawela, Ceylon*. Geol. Mag., 1960, **97**, 480–487.

An occurrence of idiomorphic, pale blue corundum crystals (sp. gr. 4·02, ω 1·770 in Na light) as porphyroblasts in biotite-sillimanite gneiss at Gangoda, 5½ miles south of Polgahawela, constitutes only the sixth record of corundum crystals in situ in Ceylon. The crystals are up to one inch long and are hexagonal prismatic, with the forms {11$\bar{2}$0}, {10$\bar{1}$1}, and {22$\bar{4}$3} most commonly developed, and show partings ‖ {0001} and {10$\bar{1}$1}, the latter due to twin lamination. The crystals are not of gem quality. The corundum porphyroblasts are surrounded by a sheath of perthitic orthoclase; the corundum-bearing bands are believed to be the product of high-grade regional metamorphism of silica-poor pelitic sediments. Pegmatite veins in the vicinity have no connection with the formation of the corundum, which is absent where a pegmatite crosses one of the bands. [M.A. **14**–296]. B. C. M. B.

Sen Gupta (Priya Ranjan). *Refractory magnetite from Sukinda, Orissa*. Quart. Journ. Geol. Min. Met. Soc. India, 1959, **31**, 147–153, 4 figs.

Magnetite inert to etch reactions is considered to be a product intermediate between hematite and magnetite formed during reduction. A. P. S.

Deshpande (S. P.). *A note on the occurrence of chalcophanite in the manganese ores of Tirodi, Balaghat district, M.P.* Current Sci., 1959, **28**, 406.

Occurrence of chalcophanite, $(MnZn)O.2MnO_2.2H_2O$, is reported as needles and aggregates associated with pyrolusite and psilomelane; identification is uncertain in the absence of X-ray and chemical data. A. P. S.

Leelanandam (Ch.). *Occurrence of monazite in granite gneisses of Kondapalle area*. Current Sci., 1960, **29**, 225–226, 1 fig.

Both euhedral and rounded grains of monazite occur in granite gneisses. A. P. S.

Benda (William K.), Erd (R. C.), & Smith (Ward C.). *Core logs from five test holes near Kramer, California*. Bull. U.S. Geol. Survey, 1960, **1045-F**, 319–393.

Colemanite is the most abundant borate mineral; veatchite [M.A. **7**–169] occurs as fine scaly crystals disseminated in montmorillonitic clay and with colemanite. The clay minerals are principally montmorillonite, hydrous mica, and attapulgite. Analcime and clinoptilolite are relatively more abundant than other zeolites. Other minerals, in varying abundance, are calcite, dolomite, halite, realgar, orpiment, detrital minerals (biotite, chlorite, quartz, plagioclase, microcline, zircon), and an unusual ferromagnetic iron sulphide of undetermined composition and unique X-ray diffraction pattern. K. S.

Patchick (Paul F.). *A Korean collecting adventure*. Rocks and Minerals, 1956, **31**, 339–345, 3 figs.

Kyanite, associated with quartz, pyrite, cordierite, and biotite, was collected at the village of Sajong near Taejon, Korea. R. S. M.

Lawrence (L. J.). *A cassiterite pseudomorph after quartz from Torrington, New South Wales.* Amer. Min., 1960, **45**, 715–717, 1 fig.

The occurrence of cassiterite pseudomorphous after crystalline quartz is recorded. A. C. H.

Smith (Howard T.). *Collecting at Mount Isa, Australia.* Rocks and Minerals, 1956, **31**, 115–118.

Experiences in collecting the following minerals in the Mount Isa Mine, Queensland, are recorded: cerussite, azurite, malachite, chrysocolla, pyrite, calcite, pyrrhotine, chalcopyrite, galena, selenite, smithsonite, native copper, and native silver. The specimens are briefly described. An account is also given of several prospecting trips in the area. An occurrence of davidite in limestone is discussed. R. S. M.

Smedley (James). *A week-end mineral collecting trip to Ontario, Canada.* Rocks and Minerals, 1956, **31**, 125–126.

Directions for reaching several important mineral localities are given. Among the minerals collected are: sodalite, nepheline, diopside, hackmanite, sphene, tourmaline (black), and apatite. R. S. M.

Moorehouse (W. W.). *Gunflint Iron Range in the vicinity of Port Arthur.* Ann. Rept. Ontario Dept. Mines, 1960, **69**, Pt. 7, 1–40, 34 figs., 10 maps.

The Gunflint Iron Formation, the lower part of the Precambrian Animikie, has three subdivisions: lower ferruginous carbonate, chert, jasper, algal chert, hematite, and taconite; a middle unit of argillite, tuff, carbonate and chert; upper thin-bedded chert, ferruginous carbonate, jasper, and taconite. These rock-types and intrusive diabase sheets are described petrographically. The minerals found in the Gunflint include quartz, chert, chalcedony, magnetite, hematite, goethite, limonite, carbonates, greenalite, stilpnomelane, minnesotaite, chamosite, and chlorite; pyrite, chalcopyrite, and apatite are local and infrequent. Organic matter occurs particularly in well-bedded carbonate rocks and in the argillites; anthraxolite, or similar brittle hydrocarbon, is associated locally with algal concretions, and carbonaceous material coats stylolitic surfaces. Spectrographic analyses of the argillites and cherty iron formation, for Cr, Co, Ni, V, B, and Rb, and several partial chemical analyses are given. The formation does not appear economically useful at present. J. A. M.

Goodwin (A. M.). *Gunflint Iron Formation of the Whitefish Lake Area, District of Thunder Bay.* Ann. Rept. Ontario Dept. Mines, 1960, **69**, pt. 7, 41–63.

A more detailed study of the Iron Formation is presented. The members, in ascending order, consist of a basal conglomerate, lower algal chert, lower shale, lower taconite, upper algal chert, upper jasper, upper shale and upper taconite. The lower taconite is made up of small granules of a mixture of greenalite, chert, and iron oxide in a fine-grained chert or carbonate matrix, and carbonate nodules are common in some beds; the upper taconite consists of thick-bedded granular chert and greenalite, with shaly partings consisting of ferruginous carbonate and magnetite. Average values for Fe and SiO_2 in potential ore-making beds are respectively: lower taconite, 25·71 and 46·44, upper jasper, 25·50 and 46·36, and upper taconite, 30·70 and 43·16%. Average chemical composition, lack of natural concentrations of ore by oxidation and leaching, and negative results of the magnetic concentration test, are not economically encouraging. J. A. M.

Schoppee (L. W.). *Mineral collecting in northern New York and southern Ontario.* Rocks and Minerals, 1956, **31**, 380–381.

Among minerals and localities mentioned are: New York—massive garnet and hornblende, Gore Mountain, North River; ilmenite and magnetite, Tahawus; talc, tremolite (fluorescent), hexagonite, Talcville; Ontario—crystalline and massive apatite, diopside, phlogopite, Sydenham; quartz nodules, pyrite and apatite in crystalline limestone, galena and blende, Seeley Bay; corundum, margarodite [damourite], chalcopyrite, magnetite, pyrite, Craigmont; graphite at Graphite; pyrrhotine, peristerite, coccolite, Maynooth; sodalite, Bancroft. R. S. M.

Richards (R. A.). *Arizona obsidian notes.* Rocks and Minerals, 1956, **31**, 585.

Special consideration is given to nodular types known locally as 'Apache tears' and 'Merikanite'. R. S. M.

Schwartz (Jack). *Obtainable minerals of Los Angeles County, California.* Rocks and Minerals, 1956, **31**, 39–41.

Seventy minerals with localities are listed. R. S. M.

Vi Gario (G.). *Notes on some Searles Lake micromounts.* Rocks and Minerals, 1956, **31**, 586–587.

Microscopic crystals of northupite, pirssonite, and gaylussite, from Searles Lake, California, are briefly described. R. S. M.

Patchick (Paul F.). *A rare-earth pegmatite near Nuevo, California.* Rocks and Minerals, 1960, **35**, 323–327, 2 figs.

The pegmatite, which cuts tonalite, composed chiefly of quartz, albite and microcline, contains andradite, monazite

(up to two inches long), xenotime (well-formed flat tetragonal bipyramids), cyrtolite (in parallel growth with yttrialite), samarskite, yttrocrasite (tentatively identified), columbite, schorl tourmaline (up to two feet long; 'sunbursts'), biotite, and kaolinite. The minerals are briefly described. Precise details on the location of the pegmatite are given. R. S. M.

Januzzi (Ronald). *Wulfenite and cerussite at Bethel, Connecticut.* Amer. Min., 1959, **44**, 1314.

Small orange, euhedral wulfenite crystals and small, equant crystals and crystalline masses of cerussite were found in tiny vugs in albite associated with quartz, muscovite, and bismutite in a complex pegmatite. B. H. B.

Seaman (David M.) & Gallant (Robert P.). *Spessartite garnet with hexoctahedral faces from Jail Hill, Haddam, Connecticut.* Rocks and Minerals, 1960, **35**, 445–448, 5 figs.

Small orange-red spessartine crystals occur within small vugs and along seams in massive garnet on Jail Hill. Most of the crystals show the {211} trapezohedron as the dominant form modified by the {321} hexoctahedron; some also show small dodecahedral faces. Refr. ind. *n* 1·79+. The massive garnet occurs as a 'pod' (5 ft. × 5 ft.) in a quartz-mica schist. Associated minerals are rhodonite, actinolite, apatite, and manganese oxides. R. S. M.

Fleener (Frank L.). *A note on mud crystals.* Rocks and Minerals, 1960, **35**, 449, & 492.

Calcite discoloured by incorporated mud occurs in ancient solution pits in Silurian dolomitic limestone near Joliet, Illinois. R. S. M.

Coulbourn (Keith). *Louisiana full of petrified wood.* Rocks and Minerals, 1956, **31**, 238–239, 3 figs.

A general report on petrified wood near Mansfield, Louisiana; logs up to 3000 pounds have been found. R. S. M.

Griesbach (John O.). *Rockville crushed stone quarry.* Rocks and Minerals, 1956, **31**, 351–353.

A rock composed mainly of diopside and andradite near Hunting Hill, Montgomery County, Maryland, contains also anthophyllite, tremolite, talc, serpentine, chlorite, chrysotile, opal, hematite, pyrolusite, and magnetite. R. S. M.

Wentworth (Ruth H.). *Hunting gold in Maine.* Rocks and Minerals, 1956, **31**, 353.

A brief account of gold panning in the Swift River at Byron, Oxford County, Maine. R. S. M.

Bryant (Stearns J.). *Fluorescing pegmatite in Maine.* Rocks and Minerals, 1960, **35**, 217–219, 1 fig.

The pegmatite of Mt. Rubellite mine, Oxford County, contains minerals which show brilliant fluorescence. A mineral species may fluoresce in different colours in different specimens. R. S. M.

Jorgensen (Neil). *A beryl occurrence at Moody Mountain, Oxford County, Maine.* Rocks and Minerals, 1960, **35**, 547–549, 2 figs.

Sea-green to deep blue beryl crystals, up to 2½ in. in diameter, occur associated with perthite, muscovite, and quartz in pegmatites cutting granodiorite. R. S. M.

Carpenter (Alden B.) & Foster (Philip C.). *Mineralogy of the Cape Rosier Mine, Hancock County, Maine.* Rocks and Minerals, 1960, **35**, 559–560.

The primary sulfide minerals in the zinc-copper mine include blende, chalcopyrite, galena, pyrite, pyrrhotine, chalcocite, and covelline. Secondary minerals include smithsonite, linarite, brochantite, aurichalcite, anglesite, azurite, malachite, hydrozincite, and cuprite. R. S. M.

Holler (Albert C.). *Minnesota staurolites.* Rocks and Minerals, 1956, **31**, 120–121, 2 figs.

Large single and twinned staurolite crystals occur in mica schist at Blanchard Dam, Royalton, Minnesota. R. S. M.

Casperson (William C.). *Heulandite and stilbite from Franklin, N.J.* Rocks and Minerals, 1956, **31**, 245.

Microscopic crystals of heulandite and stilbite occur in cavities in dolomite found on the Buckwheat dump, at the Franklin zinc mines. R. S. M.

Albanese (John S.). *A simple test for Franklin, N.J., prehnite.* Rocks and Minerals, 1956, **31**, 350.

Lamellar mass of both prehnite and margarosanite occur at Franklin, New Jersey. A drop of hydrochloric acid added to a cold nitric acid solution of the mineral will precipitate curdy lead chloride if it is margarosanite; no reaction occurs with the prehnite. R. S. M.

Sun (Ming-Shan) & Weege (R. J.). *Native selenium from Grants, New Mexico.* Amer. Min., 1959, **44**, 1309–1311.

Thin films of native selenium coat slickensides in a claystone gall. The specimen is from the middle part of the Brushy Basin member of the Morrison Formation (Jurassic), near Grants, McKinley County. B. H. B.

Rowley (Elmer B.). *Monazite and cyrtolite crystals at Day, New York, pegmatite.* Rocks and Minerals, 1960, **35**, 328–330, 1 fig.

Black tourmaline, rose quartz, polycrase, allanite, monazite, and cyrtolite occur in the Overlook pegmatite in Day, Saratoga County. Monazite and cyrtolite are briefly described. Other occurrences of these two minerals in New York are mentioned. R. S. M.

Gosse (Ralph C.). *A find of* 10,000 *Herkimer 'diamonds'*. Rocks and Minerals, 1960, **35**, 558.

A brief account is given of the discovery of many transparent, doubly terminated quartz crystals in pockets in limestone north of Fonda, Montgomery County, New York. R. S. M.

Busch (Walter). *Oklahoma zircon locality*. Rocks and Minerals, 1956, **31**, 118–119, 1 fig.

Deep reddish-brown bipyramidal zircon crystals, up to an inch across, occur in a pegmatite near Indiahoma, Comanche County. R. S. M.

Sims (Frank L.). *Petrified wood on Bellyache Creek*. Rocks and Minerals, 1960, **35**, 219.

Petrified wood occurs in Bellyache Creek near Darlington, Darlington County, South Carolina. R. S. M.

Renfro (Ruby F.). *A new occurrence of alunite*. Rocks and Minerals, 1956, **31**, 455–456.

Alunite occurs as streaks and nodules (up to 5 inches across and 1½ inches thick) in an ochre-brown shale (Eagle Ford shale, Upper Cretaceous) 7 miles west of Dallas, Texas. The alunite fluoresces a brilliant white under ultraviolet light; it is commonly associated with fibrous and crystalline gypsum. R. S. M.

Crist (Claude W., *Jr.*). *Garnet deposits in the Virginia piedmont*. Virginia Journ. Sci., 1959, **10**, 290.

General comments are given on the occurrence of garnets in the Precambrian rocks of Virginia. The rocks in which the garnets occur, and the associated minerals, but not the localities, are listed. Cummingtonite, not previously reported in Virginia, was found at several localities. R. S. M.

Pharr (R. F.) & Mitchell (R. S.). *Celestite and strontianite from Wise County, Virginia*. Virginia Journ. Sci., 1959, **10**, 295.

Celestite crystals and calciostrontianite [emmonite] globules are found in cavities in dolomite of the Cayuga group (Silurian) in a quarry about ½ mile east of East Stone Gap, Wise County, Virginia. R. S. M.

Marcin (Edward J.). *The tin mines of Irish Creek, Virginia*. Rocks and Minerals, 1960, **35**, 336–338, 2 figs.

A list is given of 32 minerals which have been found in the tin deposits at Irish Creek, Rockbridge County. The minerals are not described. Brief comments are made on the history and geology of the deposit. R. S. M.

Mitchell (R. S.) & McGavock (E. H.). *Apatite from the Morefield pegmatite, Amelia County, Virginia*. Rocks and Minerals, 1960, **35**, 553–555, 1 fig.

Grey to greenish apatite grains and crystals, up to 5 mm across, occur in cleavelandite and quartz in the Morefield pegmatite. The mineral exhibits a bright orange-yellow fluorescence in both long- and short-wave ultraviolet radiation, and also shows orange-yellow thermoluminescence. Two semiquantitative spectrographic analyses show that rare-earths (chiefly Ce and Y), Mn (up to 3% MnO), and Si are the chief trace elements. The fluorescence is probably activated by Mn. Morphological data and indexed X-ray powder data are given for the apatite. R. S. M.

Gosse (Ralph C.). *Wyoming's Sweetwater agate*. Rocks and Minerals, 1960, **35**, 451.

The moss agates found in Sweetwater County occur as smooth water-worn pebbles, seldom larger than 3 inches across. They are translucent grey, with very delicate brown or black dendrites. Many of the agates display a distinct green fluorescence. R. S. M.

O'Gara (W. T.). *General petrology of the Bucaramanga area, Department Santander, Colombia*. Rocks and Minerals, 1956, **31**, 354–356, 1 fig.

Minerals mentioned are baryte, chalcocite, galena, blende, gold, and silver. R. S. M.

VARIOUS TOPICS

Deicha (Georges). *Pétrographie microscopique en fond noir*. C.R. som. Soc. géol. France, 1959, **9**, 58–59.

Dark-ground illumination may be used to disclose fluid inclusions as well as to reveal clearly the intergranular contacts and surfaces of discontinuity between the minerals. E. J. & A. S.

Owens (George W.). *Notes on abrading materials*. Rocks & Minerals, 1956, **31**, 376–379.

Abrasives used in grinding and polishing minerals and gems are briefly discussed. Fourteen trade names are listed and the materials are defined. R. S. M.

Ives (Ronald L.). *Tezontli rock.* Rocks & Minerals, 1956, **31**, 122–124, 2 figs.

Tezontli rock, a term probably of Nahuatlan (Aztec) origin, is referred to in old mission records in southwestern United States. Researches based on writings of Fray Manuel de la Oyela y Velarte, an early Franciscan missionary, led the writer to an outcrop of typical tezontli rocks, now classified as scoriaceous basalt. In modern local usage the term refers to almost any rock other than granite and marble. R. S. M.

Albanese (John S.). *Holdenite comes out of retirement.* Rocks & Minerals, 1955, **30**, 127–128.

Some specimens labelled leucophoenicite from Franklin and Sterling Hill, New Jersey, may actually be the rare mineral holdenite. R. S. M.

Campbell (F. H.) & Mitchell (R. S.). *Sand-calcite crystals from Stoneham, Colorado.* Rocks and Minerals, 1961, **36**, 18–21, 3 figs.

White sand-calcite crystals occur in Oligocene sediments near Stoneham, Weld County. The weathered crystals, showing somewhat rounded steep rhombohedrons with rounded blunt rhombohedral terminations, range up to 23·5 mm in length and 6·5 mm in diameter. They consist of 41·4% calcite and 58·6% sand made up mainly of quartz, microcline, plagioclase, biotite, and hornblende. Nine other localities for sand-calcite crystals in the United States are listed with references ; most are Tertiary. R. S. M.

Benn (James H.). *The mineralogy of fossils.* Rocks & Minerals, 1955, **30**, 3–20, 57 figs.

The following subjects are among those discussed : pseudomorphs ; the formation of moss agate ; coalification ; petrifaction ; vivianite in fossils ; uraninite in fossils ; fossil moulds and casts ; coprolites ; false fossils including weathered rocks and concretions. R. S. M.

McConnell (Duncan). *The crystal chemistry of dahllite.* Amer. Min., 1960, **45**, 209–216, 1 fig.

The fossilized dental enamel from a mastodon tooth was examined chemically and by X-ray powder techniques. Calculations indicate that carbonate groups enter the structure as substitutions for phosphate groups. The recent supposition that carbonate can substitute for (F, OH) groups in normal apatite is untenable. A. C. H.

Wiseman (J. D. H.). *The relation between paleotemperature and carbonate in an equatorial Atlantic pilot core.* Journ. Geology, 1959, **67**, 685–690.

Isotopic temperatures determined for *Globigerinoides sacculifera* in 33 sections of drill core from the top of knoll indicate a broad correspondence between palaeo temperature and rate of accumulation of $CaCO_3$ on the se bottom. R. E. W.

Jacob (H.). *Zur Petrologie des Hochmoores Göldenitz Gubkow bei Rostock.* Neues Jahrb. Geol. Paläont Abhandl., 1959, **108**, 296–306, 4 figs., 3 pls.

The peat deposits of this moor, the largest of its kind i eastern Germany, are described. Chemical data reporte include ash content (2 to 16% in a profile of 3·2 metres bitumen content, pH, and water content. pH ranges fro 4·4 to 4·9 and varies inversely with water content. A. P.

Banerjee (B. K.), Dutta (D. P.), & Lahiri (A.). *X-ra study of Indian lignite.* Quart. Journ. Geol. Min. Met Soc. India, 1959, **31**, 17–21, 3 figs.

X-ray diffraction studies on some Indian lignites bea particularly on minor constituents such as waxy an resinous materials, fusainous patches, woody flakes, an cork-like nodules. A. P. S.

Mukherjee (Bankim) & Datta (Jayanta). *Study of th coal occurrences from Bachera area, Ranchi district north Karanpura coalfields, with special reference t their chemical and petrological characters and thei correlation.* Proc. Nat. Inst. Sci. India, 1959, **25A** 273–280, 2 pls.

A. P. S.

Kitazaki (Umeka). *Fundamental studies of the petrolog of coal with special reference to the crystalline state* Japanese Journ. Geol. Geogr., 1955, **26**, 1–46, 5 figs. 2 pls., 6 tables.

Proximate and ultimate analyses, X-ray diffractio patterns, thermal decomposition curves, heats of wetting and a number of other data are reported for numerous samples of coal and related materials varying in grade fro peat to graphite. An interpretation of the observations i terms of molecular state is attempted. A. P.

[Sidorenko (E. F.)] Сидоренко (Е. Ф.). О кварце из буроугольных отложений дубровки и глинскольвовской области [*On quartz from the lignite deposits of Doubrovk and Glinsk-Lvov region*]. Мин. Сборник Львовского Геол. Общ. [Min. Mag. Lvov Geol. Soc.], 1958, **12** 255–261, (English summary).

Crystalline quartz replacing petrified trees of Lowe Tortonian age, studied by universal stage, was found t have the optic axis orientated at an angle of 30°–32° to th wall of the strand cell and to exhibit frequently hour-glas structure. N. R.

ABBREVIATIONS AND SYMBOLS

used in the text of abstracts

M.M. .. Mineralogical Magazine : M.A. .. Mineralogical Abstracts : A.M. .. American Mineralogist

CHEMICAL & PHYSICAL-CHEMICAL

cation-exchange-capacity	c.e.c.
differential thermal analysis	d.t.a.
equivalent U_3O_8	eU_3O_8
ethylenediaminetetra-acetic acid	EDTA
heat of formation (absolute temperature subscript)	ΔH_t
ionic potential, e.g.	pH
insoluble residue	insol. res.
isotopes, e.g.	^{40}A, ^{40}K
loss on ignition	ign. loss
milliequivalent	me.
microgramme	μg
million-years	m.y.
not determined	n.d.
not found	nt. fd.
not present	nil
parts per million	p.p.m.
strength of solution, normal	*N*
— — — molar	*M*
substances in ionic state	
anions, e.g.	Cl^-, SO_4^{2-}
cations, e.g.	K^+, Fe^{2+}
valency, e.g.	Cl^{I}, Fe^{II} Fe^{III}

CRYSTALLOGRAPHIC & STRUCTURAL

Ångstrom unit (10^{-8} cm)	Å
crystal axes	*a*, *b*, *c*
— face indices	(hkl)
— form indices	{hkl}
— zone indices	[hkl]
indices of X-ray diffractions	hkl
intensity,	*I*
— relative	I/I_0
interplanar spacing	*d*
mica structural polymorphs	$1M_1$, $2M_1$
Siegbahn units	kX
space group. These words will be written in full	
unit cell, formula units	*Z*
— — repeat distances	*a*, *b*, *c*
— — reciprocal lattice lengths of edges	a^*, b^*, c^*
— — interaxial angles direct lattice	α, β, γ
— — — — reciprocal lattice	α^*, β^*, γ^*

OPTICAL

dispersion, e.g.	$r > v$
extinction angle, e.g.	$\gamma : c$
optic axial angle	2V
— — plane	O.A.P.
refractive index, in text	refr. ind.
— — of isotropic mineral	*n*
refractive indices	
of uniaxial mineral	ω, ε
of biaxial mineral	α, β, γ
sign of biaxiality	
negative	— or $2V_\alpha$
positive	+ or $2V_\gamma$

PHYSICAL (*other*)

calorie	cal.
calorie, large	kcal.
cycles per second	c/s
degree centigrade	°C
density	*D* (quote units)
— , relative, e.g.	D_4^{20}
gramme	g
hardness	H.
melting-point	m.p.
micron (10^{-4} cm)	μ
millimicron (10^{-7} cm)	mμ
pounds per square inch	lb/in²
soluble	sol.
specific gravity, terms of reference not known	sp. gr.
wavelength	λ

SYMBOLS

approximately equal to	≈
equal to	=
equal to or greater than	≥
equal to or less than	≤
greater than	>
less than	<
not equal to	≠
parallel to	∥
per cent.	%
per mille	‰
perpendicular to	⊥
proportional to	∝

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